MARCH 1960

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Keep those boiler blow-off valves in good shape .....page 18
Popular power plant cost charts have been revised .....page 20

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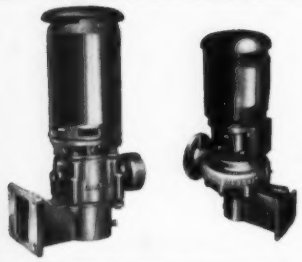

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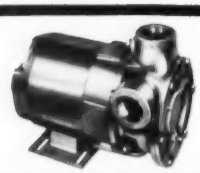

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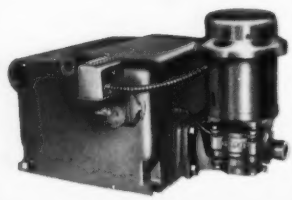

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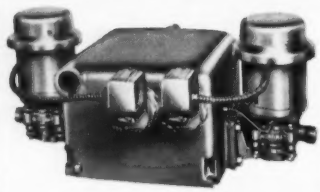

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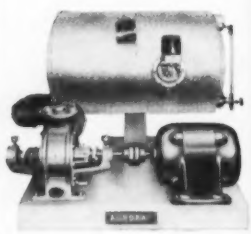
For high capacities with special conditions . . . packing box only . . . ideal for applications where return is extremely low or below floor level . . . available as either simplex or duplex units. Capacities to 100,000 EDR—pressures to 60 PSI.



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THAT'S INTERESTING

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Chromite catalysts and carbon monoxide are being used by the Franklin Institute of Philadelphia to reduce the amount of nitrogen oxides — one of the two main components of smog sent into the air from automobile exhaust.

Chromites eliminate the need for additional equipment in a system to reduce smog. In the past, to control the formation of smog by the oxidation of hydrocarbons, it has been necessary to provide a pump to bring in the additional air required to complete the oxidation.

Whether this new method of reducing photochemical smog will be the way to rid Los Angeles and other cities of eye irritating smog has not as yet been determined.

Plaster push

Plaster — a product that was used on the walls of the pyramids of Egypt 4,000 years ago — has been going thru a period of mechanization in its application in the last several years.

The case in point being a 25-story building on Lake Shore Drive in Chicago, where plaster is being pumped from a permanent mixing station on the ground through 250 feet of hose to the 20th floor into a hopper where a second machine acting as a booster pumps it another five floors.

From there the plaster can either be sprayed on the walls or there is enough to supply ten men with enough plaster for hand application.

From the time the plaster is mixed on the ground and transported through the hose to the top there is a lapse of only seven minutes.

Called the Plaster-Master, the machine is made by Santa Anita Mfg. Corp., Temple City, California.

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Steam Injection INSTANTANEOUS HOT WATER HEATERS

Shows how Pick Hot Water Heaters quickly and effectively solve hot water problems of many industries.

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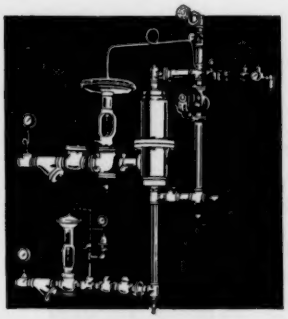

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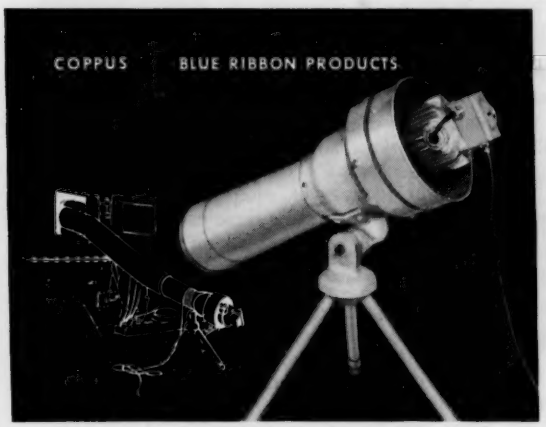

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CONVENTIONS and EXHIBITS

Feb. 29-Mar. 3: Hydro and Electric Plant Operation Institute; Department of Engineering, University of Wisconsin; Madison, Wis.

Mar. 6-9: National Electrical Industrial Show; New York Coliseum, New York, N.Y.

Mar. 6-9: ASME Gas Turbine Power and Hydraulic Conference; Rice Hotel, Houston, Texas.

Mar. 14-18: NACE 16th Annual Conference and 1960 Corrosion Show; Dallas, Tex.

Mar. 21-24: Hydro and Electric Plant Operation Institute; Department of Engineering, University of Wisconsin; Madison, Wis.

Mar. 23-26: Electrical Industry Show and Lighting Exposition; Shrine Exposition Hall, Los Angeles, Calif.

Mar. 29-31: American Power Annual Conference, sponsored by Illinois Institute of Technology; Hotel Sherman, Chicago, Ill.

Apr. 4-8: Annual Nuclear Engineering and Science Conference; New York Coliseum, New York, N.Y.

Apr. 5-7: Electrical Show for Industry; Cleveland Public Hall, Cleveland, Ohio.

Apr. 18-19: Joint Conference on Automatic Techniques; Sheraton Hotel, Cleveland, Ohio.

Apr. 25-26: ASME Maintenance and Plant Engineering Conference; Chase-Park Plaza, St. Louis, Mo.

Apr. 25-29: ASME Metals Engineering Division-AWS Conference; Biltmore Hotel, Los Angeles, Calif.

May 1-4: Air Conditioning and Refrigeration Institute (Board and Annual Meeting); The Homestead, Hot Springs, Va.

May 16-20: National Fire Protection Association Annual Meeting; Montreal, Canada.

May 22-26: ASME Oil and Gas Power Conference and Exhibit; Muehlebach, Kansas City, Mo.

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HYDROGEN
in the steam

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The oxygen set free by dissociation of the water in the boiler is equally damaging. Its presence is determined by measuring the free hydrogen in the steam condensate. Cambridge Analyzer-Recorders provide continuous records of both the oxygen dissolved in the feedwater and the hydrogen in the steam—on one chart if desired, thus enabling prompt corrective measures to be taken.

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A.S.T.M. BULLETIN D1588-58T

Describes the approved referee method of testing for gaseous hydrogen in industrial water.

CAMBRIDGE Bulletin No. 148 BP

Describes both the CAMBRIDGE Dissolved Oxygen and Dissolved Hydrogen Analyzers.

Instrument shown may be used to record either O_2 or H_2 or both simultaneously. Cambridge also makes Hydrazine Analyzers, PH Recorders and instruments for analyzing gaseous mixtures.

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ANALYZERS

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Circle 9230 inside back cover.

Specifically speaking about this issue

Several months ago, we explained in this column why PLANT AND POWER SERVICES ENGINEER was designed for "ideaists" — engineers who are looking for ideas. Just like any other news magazine, we strive to present in our editorial columns the type of news that will give our readers ideas on how to improve their operations — and, thereby, improve the environment and services necessary to their companies' productive purposes. These bits of news are presented throughout the entire magazine. News of national importance is abstracted in the "Reports in Brief" section; news of what other plants are doing is found in "New Solutions"; new product news is given in the "New Developments" section; and all just-published bulletins, catalogs and brochures are reviewed in "New Literature."

NUCLEAR STEAM

All the stories in these sections are written and presented in a style so that plant and power services engineers who are busy men can get these ideas in a hurry.

BLOW-OFF TIPS

Our cover story, this month, is one of great news value. While most of the nuclear energy hullabaloo has been centered around the generation of power, the practical applications of this energy source in U.S. industry have largely been overlooked. If you have ever wondered if nuclear energy could be used for process and space heat in your plant, you'll get an answer from the findings of Paul Geiringer, president of American Hydrotherm Corporation, who has done lots of research on the subject. We think you'll find his discussion, beginning on page 14, highly interesting.

Another feature this month is one we know many of our readers have been waiting for. This is the "Power Plant Cost" charts which have been very popular in the past.

Advisory editor, John W. Bishop, who constructed the charts has, by popular demand, revised them so that they are easier to read for small capacities. In addition, they have been extended to include larger capacities. You'll find large, workable copies of these charts on pages 20 and 22, together with the latest location factors.

NO SHAKE

If you think your boilers are plagued with gremlins, don't fret. The trouble may lie with something that often gets neglected — proper maintenance of blow-off valves. E. E. Finsel of the Yarnall-Waring Company has some good tips on how to keep these valves in shape. He presents a maintenance program that is specially designed for industrial users of blow-off valves in his article on page 18.

Vibration is another "gremlin" that plagues plant and power services engineers who are constantly working with rotating equipment. There are some very simple devices that will enable you to isolate this vibration and, thereby, reduce noise and damage. These devices are lead-asbestos pads which are installed at the base or footings of equipment. How a New York skyscraper, using these pads, kept a roof-top cooling tower from shaking up the building is told on page 13. A schematic drawing shows how the pads were installed.

KEEPS THEM ROLLING

You have probably read in the daily newspapers of the progress American Motors is making in the automobile business. One significant contribution to that progress is the work done by plant engineer C. E. Pflug and his staff. This month's reader profile tells how Mr. Pflug manages his department of 775 people to supply all the services necessary to the production of his company's automobiles.

George V. Michael

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MARCH, 1960
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Plant and Power Services Engineer

Serves the professional, technical, and practical interests of the engineers who design, install, maintain and/or operate the plant engineering services and power engineering services in industry, utilities, large service installations—and consulting and construction engineers and firms concerned with the plant and power services.

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PLUS lots of other news for plant and power services engineers

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Advertising Representatives listed on page 42

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You can obtain Thermo Electric thermocouple extension wire and cable in the widest variety of size, insulation, type and calibration, for your application—with prompt delivery of all standard materials.

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"Ceramo", Thermo Electric's metal-sheathed ceramic insulated thermocouple wire is used for extra-high temperature and nuclear applications.

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For information on selecting the right wire for your application,

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Circle 9231 inside back cover.

Atomic fusion energy: how soon?

Although significant progress has been made in the last year, we are still a long way from reaching the "ignition" temperature at which the atomic fusion process experiences sufficient fusions to balance out the energy loss and sustain itself, so John H. Williams, AEC commissioner told the American Petroleum Institute recently.

Mr. Williams gave three principal reasons for continued research in fusion power despite the fact it has been estimated that "the reserve of fissionable material is large enough to sustain humanity for the indefinite future." One very strong reason is the lesser extent of the problem of special disposal of radioactive fission process wastes. Secondly, the thermonuclear, or fusion reaction is inherently a safe reaction, in that it will die off very rapidly if operating conditions are not precisely maintained. And thirdly, fissionable materials, although plentiful, will become increasingly difficult and expensive to obtain, as the richest sources are exhausted. Reserves of fusion materials, on the other hand, are in effect inexhaustible and may well become more economical to utilize.

About 330 scientific people are currently working on the U.S. controlled thermonuclear research program, referred to as Project Sherwood. First goal of the program is to bring the nuclei in the reaction to the "ignition" temperature, which for a mixture of deuterium and tritium gases is about 50 million degrees Kelvin. Magnetic fields are being manipulated to exert a pressure on the hot plasma, or gas mixture, and isolate it from the confining walls. Plasma temperatures of about 10 million Kelvin have been achieved so far. When the "ignition" temperature is reached, Mr. Williams points out, we will have reached the stage of development that the atomic fission program reached on December 2, 1942 when the first chain reaction was achieved.

Second goal will be to build a machine or reactor that will have a net power output on a sustained basis and then convert the energy of fusion into mechanical or electrical power. It is believed that the accomplishment of this end may well be fifteen or twenty years away.

Better rental methods for data-processing systems

A new leasing plan for electronic data-processing systems has been announced by the Datamatic Division of the Minneapolis-Honeywell Regulator Company. The plan is a departure from the industry's established 8-hours-daily rental pricing methods, in that it allows use of an electronic data-processing system for 176 hours a month on any time schedules required to fill the customer's needs.

Heretofore, users have paid rent on their systems on a conventional basis of 22 standard weekday shifts of eight hours each and have been charged overtime for work done outside these periods regardless of whether the user had employed his computer fully during the regular shifts. Frequently, data-processing requirements of the average company entail peak loads of work, usually occuring toward the end of the month and requiring using the computer for more than eight hours in any given day.

It is said that the Honeywell 176-hour plan will enable many users to eliminate complex and costly scheduling and re-scheduling difficulties in handling their normal work.

Jet-powered gas turbine compressor station

New jet-powered gas turbine compressor station plans have been approved by the Federal Power Commission. Incorporating the new type 10,500 horsepower gas turbine being developed jointly by Cooper-Bessemer and Pratt & Whitney Aircraft, the turbine utilizes a modified J-57 jet aircraft engine as the power generator.

The tremendous thrust of this gas-fueled unit is converted into rotating horsepower by a specially designed turbine, and this drives a centrifugal compressor.

It is expected that the facilities will be completed in the summer of 1960.

Fourth process for salt water conversion

Secretary of the Interior Seaton has announced selection of the forced-circulation vapor-compression distillation process for the fourth saline water demonstration plant. The plant will be designed to convert saline water to fresh, at an anticipated rate of at least 100,000 gallons a day.

Exact location of this plant in the Northern Great Plains or the Southwest as well as the location of the third demonstration plant, which will also convert brackish water to fresh, will be announced in the near future.

The forced-circulation vapor-compression process was selected because it achieves very high heat-use efficiency. The saline water is boiled in tubes. The resulting steam is collected and compressed, thus raising its temperature, and returned to the heating side of the evaporator tubes as the principal heat source of the plant. The compressed steam condenses as it gives up its heat to the saline water in the evaporator tubes and becomes the fresh water product of the plant.

Quartz infrared lamps give more heat

Recently announced quartz infrared lamps provide twenty times greater concentration of radiant energy than ever before possible.

They are said to produce the shortest infrared wavelengths of any commercially available high wattage infrared source, making them the most economical heat source for many infrared applications.

The infrared lamps will provide thousands of degrees of temperature almost instantaneously, yet are so resistant to thermal shock that ice water can be poured over a red hot lamp without danger of cracking. They can be used in industry for many drying, baking and dehydrating applications.

The small diameter of the lamp tube makes it possible to mount a number of them in a very small space to achieve an extreme concentration of radiant energy.

Five different quartz lamps ranging from 500 to 1350 watts, in lengths from five to ten inches are being offered initially. Other sizes will be available in the future.

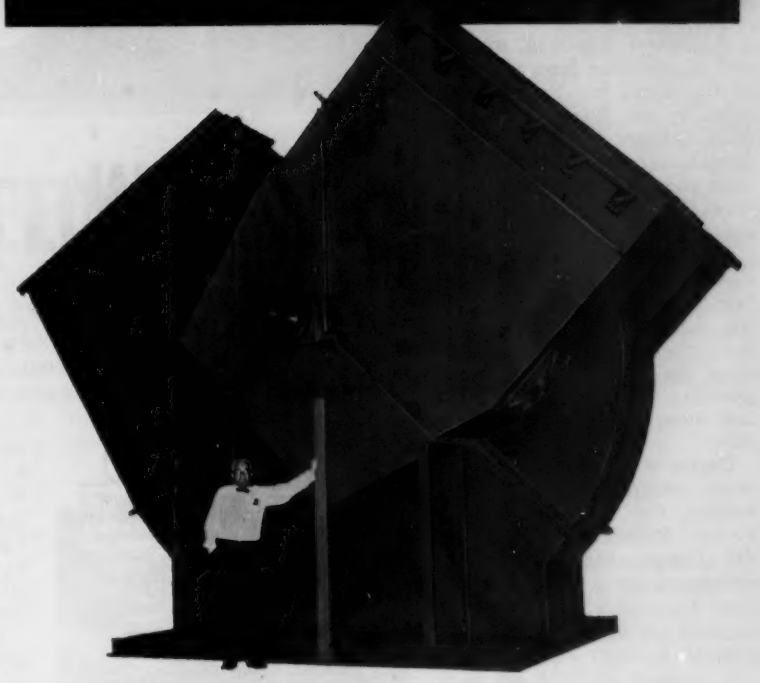
(Quartz lamps are product of Westinghouse Electric Corp., Lamp division, Dept. P&PSE, Bloomfield, N.J.)
Circle 9232 inside back cover.

Exotic power generation to be discussed

A forum devoted to unconventional methods of generating power will be one of the features of the 22nd annual American Power Conference to be held March 29 through 31 at the Sherman Hotel, Chicago, Ill.

Research experts will discuss the fuel cell, the nuclear rocket program, isotopic heat and power, and magnetohydrodynamics at the three-day meeting sponsored annually by the Illinois Institute of Technology.

Where Severe Applications are Standard



WHIRLEX HEAVY DUTY FANS

TAKE OVER . . . Efficiently

This heavy duty WHIRLEX exhaust fan was custom designed for iron ore sintering machine. The unit is designed to carry hot gases at the rate of 200,000 CFM with 35 in. W.G. static pressure and is complete with scroll liner, cheek plate liner, blade wear pads, inlet louvre control dampers and removable section.

Additional facts and operating data on this and other WHIRLEX custom design fans are available at your request.

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207 North 1st. Street • Birmingham, Ala.

Dust Collectors • Induced Draft Fans
Forced Draft Fans • Exhaust Fans
Self Supporting Stacks • Duct Work

FLY ASH WHIRLEX ARRESTOR

Circle 9233 inside back cover.

Digest of state pollution control laws is published

A revised digest of water and air pollution laws of each of the states has been compiled by the Western Petroleum Refiners Association. Information concerning Federal laws and laws for Alaska and Hawaii will also be available shortly.

For each state the digest covers the state agency, the law, the powers and duties of the control board or commission, the rules and regulations, the issuance of permits, penalties and enforcement, and other pertinent information.

Copies of the digest for any state can be obtained by writing the Western Petroleum Refiners Association, 416 Beacon Bldg., Tulsa 3, Oklahoma.

More about industry's 'hidden disease'

Still another top executive in industry has come forward in support of the plea for more adequate depreciation allowances first voiced by Mr. James P. Stewart, president, De Laval Steam Turbine Co., in the July issue of PLANT AND POWER SERVICES ENGINEER.

In a guest editorial in the Tulane Alumni Business Review entitled "The Hidden Disease of Industry," Mr. T. C. Davis, a vice-president of Du Pont said, that "industry is obliged to operate in an inflation economy under a disastrously unrealistic depreciation policy" which obstructs the replacement and modernization of productive facilities.

"The problem is now being obscured by the high level of industrial activity," Mr. Davis said. But he warned that "we are only eight or ten years away from the time when our population will reach 200 million, bringing with it a demand to increase our gross national product from $475 billion or so to nearly $700 billion — unless we are willing to accept substantially lower living standards.

SARCO

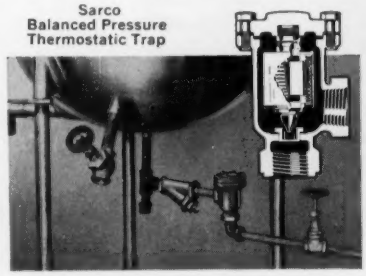
NOW... MATCH STEAM TRAPS

THERE'S no such thing as an all-purpose steam trap. That's why it pays to know what each trap has to offer. Here are five examples that demonstrate how you can match the correct steam trap type to the exact requirements of *each* application.

EXAMPLE 1: Outside Tracer Lines: A tough set of requirements

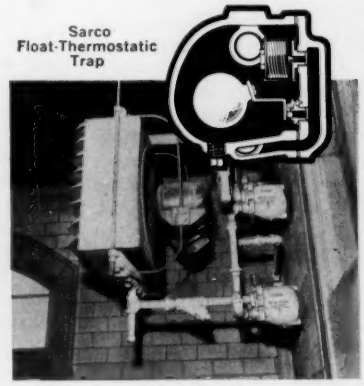
One of the most demanding sets of requirements a steam trap has to face is found in *outside steam tracing*. The trap must not only rid tracer lines of condensate and air immediately they're formed, but it must do so under exacting conditions. Pressures on each trap may vary widely. Installations may be remote and inaccessible to service. Water hammer may be a constant threat; freezing may be a hazard. Only the unique Thermo-Dynamic trap takes all these demands in stride. The Sarco TD-50 operates perfectly *without adjustment* through its full pressure range of 10-600 psi. It's virtually immune to water hammer and won't freeze when installed with a free discharge. Maintenance is, therefore, negligible. Compact, requiring no external support, the TD-50 is just about the easiest trap in the world to install. Once it's installed, you can forget it. You can count on an extremely long, trouble-free service life with minimum maintenance attention.

More closely than any other model, the TD-50 approximates an all-purpose trap. However, special application requirements might dictate the use of another type of Sarco trap. Sarco engineers stand ready to help you solve any trapping problems.



EXAMPLE 2: For steam jacketed process kettles: a trap that operates immediately on start-up and self adjusts to both low and high pressures

When a large steam-jacketed process kettle starts up, the condensate load is high, and all air in the jacket must be released quickly. At this stage, however, the jacket pressure is low; yet it builds up rapidly as the process continues. Because a SARCO No. 9 Balanced Pressure Thermostatic Trap is wide open on start-up, it releases initial air and condensate without the need for a bypass. And because it is self-adjusting, it works just as efficiently during the first processing stage when the jacket pressure is high. There are no seats to change for various working pressures. You can see why it is the obvious choice for steam jacketed process kettles.



EXAMPLE 3: How to prevent water-logging in unit heaters and blast coils

All unit heaters and blast coils have a relatively small internal volume in comparison with their steam condensing capacity. Even slight water-logging can reduce heat output seri-

Impartial advice on trapping because
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TOPICS

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ously. Pressures may vary widely under automatic temperature control and so may the load because of variable demand. A trap to handle this application must adjust itself instantly to pressure and load charges. The most precise answer to this problem is the SARCO Float and Thermostatic Trap—and here's why: it releases air on start-up and during running, and, because it discharges condensate continuously, it does not set up in the system violent pressure changes that would upset close control.

Sarco Liquid Expansion Trap

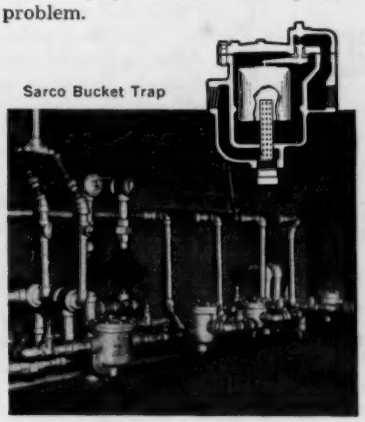
EXAMPLE 4: How to release low temperature condensate

When condensate cannot be returned to the boiler feed tank either because of distance or because it may be contaminated, it's economical to utilize some of the sensible heat as well as the latent heat of the steam.

For this purpose a trap must be capable of releasing condensate to temperatures as low as 100° F.

The sound trap selection here is the SARCO No. 871 Liquid Expansion Trap because it can be set to release condensate at temperatures down to 100° F. regardless of supply pressure. This performance assures maximum steam economy. The Sarco No. 871 handles the starting load easily because of its wide open valve, which throttles the flow as the condensate temperature rises. Furthermore waterhammer cannot reach the operating element. No other type is as nearly perfect for this specific problem.

Sarco Bucket Trap



EXAMPLE 5: Economic handling of Water Hammer and Corrosive Conditions

In applications in which water hammer or corrosive conditions are encountered but in which low pressures or extremely high back pressures preclude the use of the Thermo-Dynamic trap, the Sarco Inverted Bucket Trap is recommended. While the Sarco I. B. is not exactly a fuel miser, its relatively rugged construction will withstand considerable water hammer; and, when it is fitted with stainless steel internal parts, it offers excellent resistance to corrosion.

* * *

CONCLUSION: The right application is the economical installation

When you choose steam traps that serve their purpose without frequent adjustment, and without maintenance or replacement problems, you save on down-time, man-hours, spare parts, and production slowdowns.

You can get the money-saving solution to every trap selection problem by consulting Sarco. You get impartial solutions, because only Sarco makes all 5 types of steam traps: Thermo-Dynamic*, Thermostatic, Float Thermostatic, Liquid Expansion, and Bucket.

You also get the benefit of Sarco's 50 years of specialized experience in the manufacture and application of temperature regulators, industrial air vents, pipeline strainers, dial and industrial thermometers, heating and cooling controls, heat exchangers, heating control systems and heating specialties.

For literature or impartial help in solving your steam trapping or control problems, contact your local Sarco Sales Representative, or write direct to Sarco. 1440

*U.S. Pat. No. 2,817,353, T.M. Reg. U.S. Pat. Off.

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Circle 9234 inside back cover.

"American industry is rightly expected to provide enormous productive facilities to meet these needs and also to be prepared for any emergency call from the government. The income tax law has always recognized the necessity of permitting industry to accumulate funds year by year so as to be able to modernize or replace worn-out or obsolete plants and equipment as the need arises." However, Mr. Davis pointed out, "The law makes no allowance for inflation, which has greatly increased the cost of doing this."

Paper on aluminum substations

A paper on "Aluminum Alloy Substation Structures" as opposed to galvanized steel was presented at the Summer and Pacific General Meeting of the AIEE in Seattle.

Recent availability of aluminum standard structural shapes and price reduction have furthered utilities' consideration of all-aluminum substations.

The first all-aluminum substation in this country was built for ALCOA's research laboratory at New Kensington, Pa., by Delta-Star Electric Division of H. K. Porter Company, Inc.

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Navy offers manuals on power generation and distribution

Four sections of the U.S. Navy Bureau of Yards and Docks engineering manuals on power generation and distribution have been published for sale to the public by the Office of Technical Services, Business and Defense Services Administration, U.S. Department of Commerce, Washington 25, D.C.

Chapter on mobile emergency power plants gives the specifications and outlines maintenance and operation of emergency power plants, emergency electric generator equipment, steam railway power plants, and mobile and portable diesel-electric generating plants. (Order PB 161056; price $1.75)

The chapter on fuels is limited to a discussion of coal as a fuel, with later publications to take up liquid and gaseous fuels. Contains sections on properties of coal, sizing of coal, analysis, coal contracts, handling and storage, firing equipment and firing, regulating and recording devices, ash and gas disposal, plant management, and automation and controls. (Order PB 161058; price $2.75)

The chapter on power plant water conditioning discusses design, construction, operation and maintenance of power plant water condition systems. Design and construction covers in detail chemical analysis, feedwater treatment, treatment plants, secondary internal treatment, and laboratory and testing equipment. Operation and maintenance includes external treatment plants, secondary treatment, chemical testing procedures, care of idle boilers, prevention of return-condensate corrosion, and safety precautions. (Order PB 161055; price is $2.50)

Section on distribution of steam, high-temperature water and compressed air covers design, construction, operation and maintenance of steam, high-temperature water and compressed air distribution systems. Specific types of overhead and underground systems are discussed. Applicable load assemblies, routes and pressures are presented. The discussion on maintenance and operation is primarily concerned with overhead and underground distribution systems and with traps, valves, fittings and piping that make up these systems. (Order PB 161057; price is $1.00)

Plans $50-million project to 'store' electricity

Union Electric Company, St. Louis, Mo., is planning a $50-million installation to "store" electricity by using steam-generated electricity to pump water uphill during the night and generate electricity from the same water running downhill during the day.

The project is expected to provide an additional 350,000 kilowatts of daytime peak capacity by the time of its completion in the spring of 1963.

The company asserts its "pumped storage" project is larger than similar projects under construction at Niagara Falls and in Great Britain. It has been made possible by the development in recent years of pumping equipment that, when operated in reverse, generates electricity.

Idle steam power will be used to pump water 1000 feet uphill during the night, when most industrial and commercial customers are shut down.

Approximately three kilowatt hours of nighttime power will be required to pump uphill the water required to make, going downhill, two kilowatt hours in the daytime.

According to company officials the economies resulting from the project would be "substantial." Chief among these is the deferral for two years of the beginning of construction of a new, more costly steam generating plant elsewhere on the Union Electric system. The utility now has a 350,000-kilowatt steam generator under construction at its Meramec plant in south St. Louis county.

Industry — largest user of water

Water use in the U.S. in 1959 approached 300 billion gallons per day, with Steel being the biggest water user among various industries.

Forty-six percent of the total went for industrial and power generating purposes. Agricultural irrigation used almost as much (45 percent). Only 8 percent went into municipal water systems.

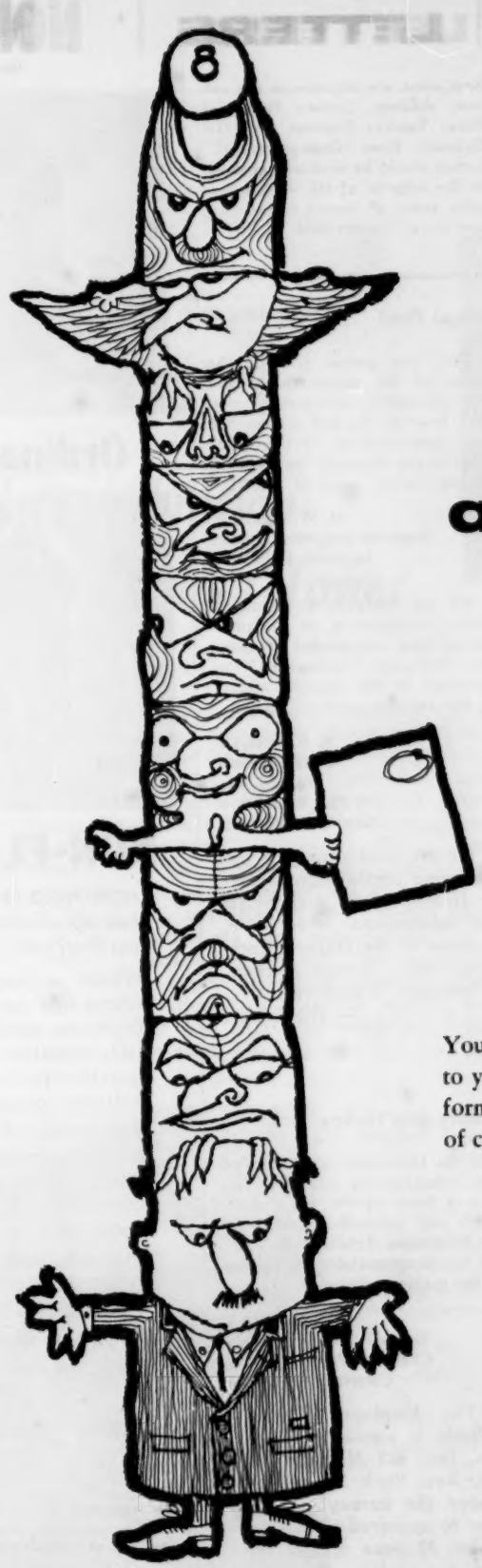
In the larger industrial plants, water usage is divided into: cooling, 54%; processing, 32%; power generation, 9%; with fire protection, sanitary services and miscellaneous uses making up the other 5%.

Institute analyzes heat cycles

Institute of Practical Heat Cycle Analysis has been formed by Bailey Meter Company at its Wickliffe, Ohio Plant.

Reasons for forming the Institute are two-fold: First, it is designed as a service to the company's customers to assist results- and test-engineers from companies who have purchased automatic heat cycle monitoring and test equipment in obtaining maximum benefit from its use. Second, it will provide a focal point for information on cycle analysis and by providing an opportunity for engineers to discuss common problems with each other and with top men in the fields of instrumentation, boiler design and turbine design.

The first workshop session consisted mainly of talks and round-table discussions covering such subjects as high accuracy measurement and testing, turbine and heater characteristics, and the "gain" approach to cycle analysis. Visiting engineers made calculations and studied methods of setting up computer programs for heat rate problems, analyzed different cycles and determined cycle malfunctions from data intentionally provided for this purpose.



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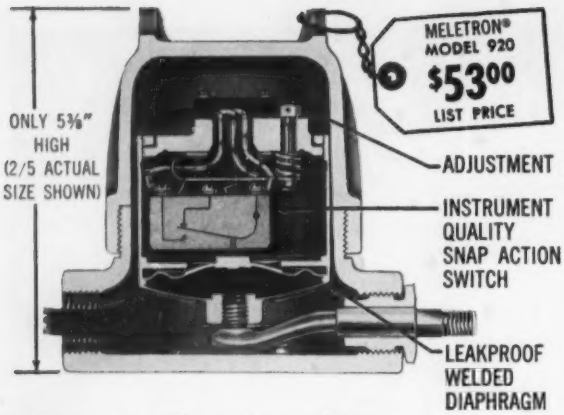

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LETTERS

Your views are welcome in this column. Address "Letters, Plant and Power Services Engineer, 111 East Delaware Place, Chicago 11, Ill." Letters should be brief and confined to the editorial of this magazine or other topics of interest to the plant and power services field.

Help! Fire!

Will you please give us the name of the manufacturer and any pertinent information you may have on the fire extinguisher that uses DuPont "Freon-13B?" This article appeared on page 10 of the January issue of P&PSE.

D. W. KELSEY
Imperial Irrigation District
Imperial, California

We are interested in obtaining further information on the pressurized fire extinguisher containing DuPont's "Freon-13B1" as described in the Reports section of the January issue of P&PSE.

R. E. NAGLE
Chief Engineer
Texaco, Inc.
135 East 42nd Street
New York 17, N.Y.

• *We are unable to give you the name of the manufacturer. However, you may obtain the information from F. R. Zumbro of the DuPont Company, 8531 Nemours Bldg., Wilmington, Delaware.*

— The Editors

Wants pay survey

In the December, 1959 issue of your magazine on page 11, you gave a brief review of a foreman's pay survey conducted by the Employee Relations Bulletin. We would appreciate your giving us the mailing address.

J. L. GRAY
Executive Vice President
Chemical Products Corp.
Cartersville, Georgia

• *The Employee Relations Bulletin is published by Vision, Inc., 635 Madison Avenue, New York 22, N.Y. We believe the survey that you refer to appeared in the September 30 issue of that Bulletin.*

— The Editors

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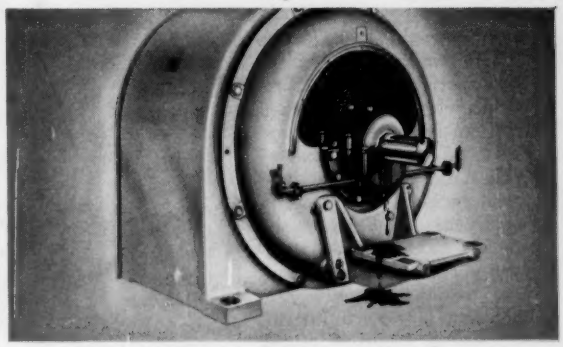
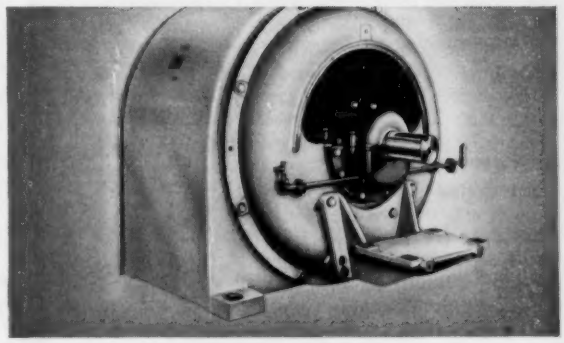


Ordinary Oils Drip Out



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Circle 9237 inside back cover.

MARCH, 1960
VOL. 2 NO. 3
Plant Power Services Engineer

Are you plagued with vibration? If so, read how a New York skyscraper uses lead-asbestos pads to . . .

Isolate Vibration Of Roof-top Cooling Tower

Pads' construction is shown by this cut-away view of a sample (oversized) piece

One of the first installations using lead anti-vibration pads to damp the vibration created by air conditioning equipment was made on the roof of the new 35-story office building at 575 Lexington Ave., New York City.

The roof-top cooling tower — with a wet weight of 205,000 lb — is supported on 10 steel angle-columns resting on the building's own structural girders. Because vibration in the cooling tower would be transmitted to the building structure, lead-asbestos pads were placed between the base of the cooling tower's supporting columns and the structural steel. Steel billets distribute the load over the pads.

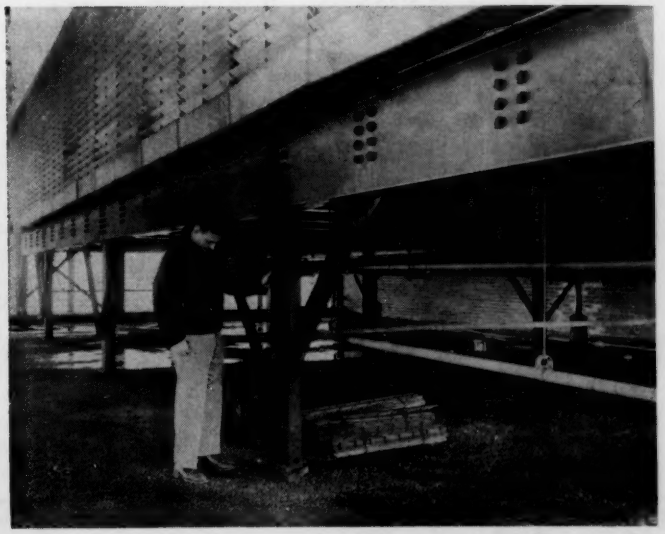
The tower's corner posts are on pads measuring 8" by 8" and the remaining columns are on pads which measure 8" by 14". The ten pads provide an anti-vibration bearing surface of 928 sq ft for the 205,000-lb tower — or about 220 lb per sq in.

Engineers reported that the method of construction used for the supports saved considerable time and expense in that they could be placed in position while the steel work was in progress rather than waiting for the concrete to be poured and then placing the footings.

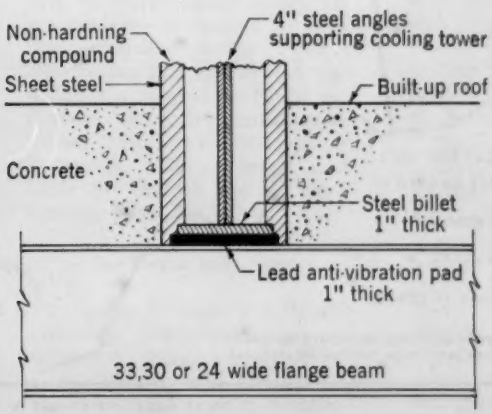
The cooling tower is equipped with three 60-hp, 1800-rpm motors with spiral bevel gears driving a 12-bladed, adjustable-pitch fan at 202 rpm, and a water pump of 6000-gpm capacity.

As revealed by a recent check this past summer, the vibration created by this equipment while operating at peak load was effectively damped by the lead-asbestos anti-vibration pads.

(More information on anti-vibration pads may be obtained from Lead Industries Association, Dept., P&PSE, 60 East 42nd St., New York 17, New York.)
Circle 9238 inside back cover.



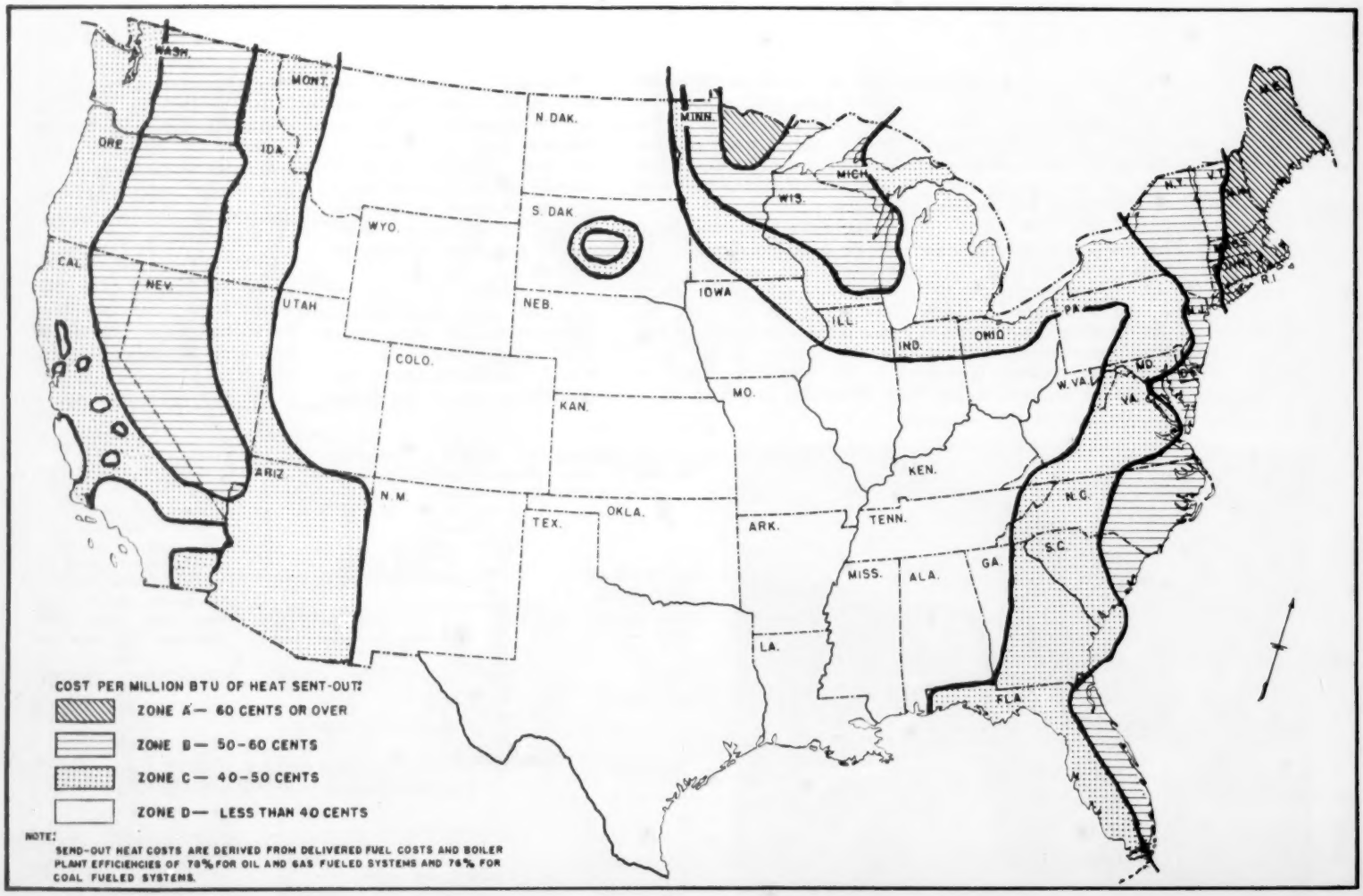
◀ Roof-top cooling tower is mounted on lead-asbestos pads to isolate vibration from the building. Pads foot directly on beams



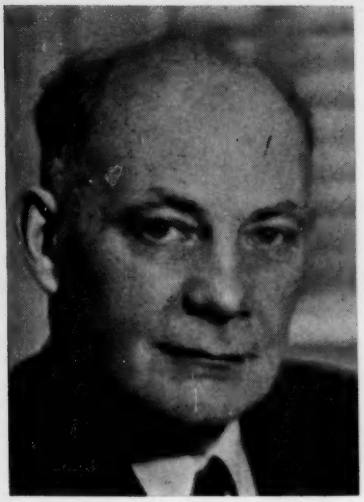
◀ The pads were placed between the tower's supporting columns and the structural steel. Steel billets distribute load over the pads

Nuclear Energy for Process and Space Heat — What is the Potential in U.S. Industry?

PAUL L. GEIRINGER
President
American Hydrotherm Corporation
Long Island City, N.Y.



HEAT COST VARIATIONS IN THE UNITED STATES.



Mr. Geiringer recently completed a study for the AEC on the potential applications of nuclear energy for process and space heating. The results of that study are presented in this article written by Mr. Geiringer for PLANT and POWER SERVICES ENGINEER. Readers who have wondered about the possibilities of nuclear energy for industrial uses will find his conclusions highly interesting.

To date, the major share of both engineering talent and plant investment in practical applications of nuclear energy have focused on a single area—large installations for generation of electric power. There are good reasons for this concentration: Nuclear power looks promising for electrical power production. In addition, the public utilities are eminently qualified to undertake projects of this type. They are substantial organizations with the necessary financial resources and manpower to see the program to completion.

There are, however, many other areas of industry where more moderate users of energy might profit by advances in nuclear development. The Atomic Energy Commission, the design-engineering service industry and the industrial community as a whole, all have a mutual interest in developing nuclear power as a source of energy for a much larger segment of industry.

Such was the reasoning which led the AEC recently to sponsor a study by my firm, The American Hydrotherm Corporation, on the possibilities of using nuclear energy in the space and process heating fields. Mainly, our study concerned itself with the answering of two key questions:

1) Will nuclear energy do the job more economically?

2) And if so, will it do the job better?

In addition, the following very important practical and commercial questions need answering:

3) Will reactor operation be foolproof, permitting safe location of reactors in close proximity to manufacturing establishments?

4) Will a record of safe reactor operation stabilize such variables as safety requirements, insurance coverage, etc.?

Unless the first two questions can be answered affirmatively, and the second two resolved to the satisfaction of the business community, there is no chance of real acceptance of nuclear energy for space and process heating.

While the economics are certainly the most important aspect, it is necessary to form a basis on which a realistic economic analysis can be made.

Therefore in seeking an answer to these questions, the smallest feasible reactor size must be determined to evaluate initially the area of potential use of nuclear energy for industrial applications.

Reactor Considerations

Reactor technology is far from static in the present developmental stage of nuclear engineering. But the best information available points presently to a minimum feasible reactor size of 20 megawatts (approximately 60 million Btu/hr or 2000 boiler horsepower).

This limit, dictated essentially by the economics of reactor design and operation, is expected to drop appreciably, with increased experience and new developments in the field. Recent developments point to an economical reactor design in the not-too-distant future of half the above output or 10 megawatts.

The Atomic Energy Commission has made studies on larger, 40-megawatt capacity reactors for process and space heating, directing their attention primarily to Pressurized Water Reactors. Using 40 megawatts as a minimum size for economic feasibility would substantially reduce the number of potential industrial users. While the minimum sized reactor is still a subject of discussion, it is, nevertheless, our opinion that the figures—presently of 20 megawatts and in the near future of 10 megawatts—correspond favorably wih present technology.

Happily, there is a wide area of the industrial community using heat energy for processing or space heating at rates equal to or above this 10-megawatts (34 million Btu/hr) size. Some twenty categories of heat users were investigated showing a total of 4755 installations.

Of these, over 650 fall into "Zone A," that portion of the United States which, due to high cost of fossil fuels, is deemed practical for immediate conversion to nuclear energy. Table I summarizes this information and includes a breakdown of the industrial categories investigated. These constitute the major groupings utilizing large heat loads for process and/or space heating. Page 16.

The Reactor Heat Plant

In order to explore fully the problems and possibilities, we decided to design a practical reactor. The Atomic Energy Division of the American Standard Corporation designed the 20-megawatt unit on the basis of design specifications supplied by American Hydrotherm Corporation to meet the requirements of industry for such a unit.

At the onset, we knew that reactors to meet process and space heat requirements call for considerably less initial investment than power reactors, since they operate at lower temperature and pressure potentials. Steam temperatures ranging from about 200°F to 450°F, for example, are normal in the industrial field. This means that service and design standards for both the auxiliary reactor equipment as well as the reactor itself are lower.

To meet these requirements of low-temperature heat generation, a Boiling Water Reactor similar to the unit developed at the Argonne Laboratories was selected as the most suitable. The selection was made after an evaluation of several reactor types and the final design had, as a principal objective, a safe and reliable plant which would produce low-cost heat ultimately delivered to heat users in the form of high-temperature water or steam.

The core for the 20-megawatt reactor, housed in a vertical pressure vessel of approximately 4½ ft diameter by 15 ft in height, consists of 88 fuel elements each with 24 fuel plates separated by coolant channels. Fuel plates are clad with an aluminum alloy (designated X-8001) which, on the basis of experimental evidence and service experience, will give full power operation for

To next page

Nuclear space and process heat

From preceding page

a two-year period at 80 percent load factor.

This would produce approximately 40 percent fuel burnup, the expected maximum obtainable for this type fuel element. If longer core life is desired as a result of a lower plant load factor, cladding thickness can be increased to enable longer core life.

The core generates maximum 450°F saturated steam at 407 psig. This is piped directly to the main heat exchanger. Here it is condensed and cooled, while heating a secondary fluid from 200°F to a maximum 400°F, which can be circulated to plant users without any harmful gamma radiation. Either steam or high temperature water can be delivered from the main heat exchanger to the final heat users.

The entire reactor core, main heat exchanger, operating and safety auxiliaries which require containment, are housed in a vessel 50 ft in diameter by 75 ft in height. In the unlikely event of a major nuclear accident, plant personnel as well as adjacent population would be protected.

Economics

Having established that a segment of industry exists which could use the 20-megawatt reactor developed for space and process heating, a single critical question remains: Will nuclear operation be cheaper than the present fossil fuel method? And if so, what are the conditions needed to bring about this saving?

Table II summarizes fixed costs for nuclear and conventional fossil fuel heating plants of 20-megawatt capacity. Adding to the fixed costs of the nuclear plant the total fuel cost of 48.8¢ per million-Btu results in a total heat cost of $1.028 per million-Btu-delivered-heat. Adding the total fixed charge for conventional plants (30.6¢ and 20.4¢ per million-Btu respectively for coal and oil or gas fired plants) to the local fuel cost per million-Btu of delivered heat will provide a basis for comparison between nuclear and conventional plants.

Since fossil fuel costs vary by geographic areas, it was necessary to derive fuel costs throughout the United States. We divided the country into four major zones where the cost of fuel per million-Btu of delivered heat varied as follows (See Map):

Zones of Varying Fuel Costs in U.S.

Zone	Total fuel cost per million btu delivered heat	Area
A	60c & over	Comprises most of New England, Northern Minnesota and all of Alaska
B	50c to 60c	Comprises most of Eastern Seaboard, Rocky Mountain and Northern Great Lakes area
C	40c to 50c	Comprises most of Western Seaboard, East Rocky Mt. States, Southern Great Lakes area and just west of Atlantic Seaboard
D	under 40c	Balance of continental United States

Referring to Table I, a breakdown is given showing the number of installations in each of the above zones, indicative of market potential for large sized process and space heating installations.

Summarized in Table IV are results of adding to the fixed costs the total fuel cost per million Btu of delivered heat. This gives the total "send out" cost of heat. The first three columns show "send out" cost of nuclear heat which vary depending on type of fuel elements used and plutonium credit allowance established by the AEC. Table III shows three different nuclear fuel costs showing the effects of varying plutonium credit rates.

Similarly the total "send out" cost is tabulated for conventionally fired plants in Zones A, B and C. It can be seen from this tabulation the relative competitive position of a nuclear heat plant and a fossil-fueled plant of corresponding size.

For instance, on the basis of slightly enriched fuel elements with $12.00 per gram plutonium credit, a nuclear plant is immediately competitive with coal fired plants in Zone A.

Zone A is considered an area of immediate potential for nuclear energy, while Zone B would have potential in the near future, should reactor technology reduce initial investment costs of nuclear installations. Similarly, the general trend of rising fossil fuel prices due in part to higher exploitation cost of lower grade fuel reserves might hasten the competitive threshold in Zone B.

Additional Considerations of Nuclear Heat

While the economic analysis will necessarily be the determining one in final selection or rejection of nuclear energy for space or process heat, there are added advantages to nuclear operation which must be considered.

Nuclear heating will permit location of plants in the most inaccessible areas since there is no dependence on bulk fuel delivery. Fuel storage is of no problem with the result that space can be utilized more efficiently. Increased service experience with nuclear reactors will tend to reduce hesitation which now exists due to safety considerations.

Wider use of nuclear reactors will take the "mystery" out of such installations with resulting broader acceptance in the general population. Plant sites near urban populations will become commonplace. Finally, isotope production is a potentially profitable by-product in the production of nuclear heat.

TABLE I — ESTIMATED NUMBER OF LARGE HEAT USERS IN THE U.S.
By industry and zone of economic potential for nuclear heat

	TOTAL	ZONE A	ZONE B	ZONE C
TOTAL	**4755**	**669**	**1201**	**2885**
Process Heat Users — Total	**2341**	**344**	**619**	**1378**
Chemicals and allied products	517	34	136	347
Pulp, paper and paperboard	534	93	194	247
Food and kindred products	420	18	96	306
Textile mill products	417	120	94	203
Rubber products	188	42	34	112
Plywood and other wood products	102	3	19	80
Leather tanning and finishing	88	27	27	34
Synthetic fibers	31	3	8	20
Hard surfaced floor coverings	27	4	9	14
Tobacco	18	.....	2	15
Space Heat Users — Total	**2414**	**325**	**582**	**1507**
Industrial Plants	1303	179	266	858
Military Bases	328	50	88	190
Hospitals	279	45	83	151
Colleges and Universities	244	25	70	149
District Heating Plants	80	9	19	52
Prisons & Correctional Inst.	54	2	12	40
Public Housing Developments	44	8	22	14
Public Buildings	30	1	10	19
Airports	24	4	5	15
Other Buildings*	28	2	7	19

*"Other Buildings" refers to miscellaneous installations reported by state governments. They do not fit into the categories listed above, but nevertheless have heat loads above the minimum under study. It should be further noted that not included in this report are many urban installations which, while having heat loads above the minimum, are not considered the most feasible to exploit nuclear heat because of their proximity to large and densely populated areas. As use of reactors extends, these urban establishments might represent a very imposing potential for nuclear heat. With proved safety performance of reactors, nuclear heat could take over such large users as transportation terminals, hotels, office buildings, banks, department stores, museums, indoor sports arenas, etc.

Some variables remain in the economic area which, until resolved, will make more difficult managerial decisions in favor of nuclear heat plants. Among these are safety requirements which quite naturally will vary with increased experience with nuclear reactors. They should be subject to regular review and revised when they tend to over-penalize nuclear installations for no apparent or actual safeguard.

Another area of concern is that of insurance coverage. Management will want to be assured of both a fair premium and, within normal economic fluctuations, a stable one.

With such variables as these, it is impossible to make clear-cut decisions. Management is naturally hesitant in moving ahead with a new technology without first satisfactorily resolving them.

Nevertheless, the inescapable conclusion is that further reduction of reactor costs, which can legitimately be expected with advancing nuclear technology, make consideration of nuclear energy for space and process heating mandatory for plant and power services engineers whose installations now produce ten megawatts of heat or more.

The final decision will rest on availability and price of fossil fuels in the particular area of operation. But the plant and power services engineer might well inform himself on rudiments of nuclear technology, for the use of nuclear reactors for space and process heating promises to become one of the largest future applications of nuclear energy.

This article is based on a report prepared by the American Hydrotherm Corporation for the Atomic Energy Commission, entitled "Potential Applications of Nuclear Energy for Process and Space Heat in the United States." The complete, almost-300-page report is available from the Office of Technical Services, Department of Commerce, Washington 25, D.C. Ask for Report NYO 2332, priced at $2.75.

TABLE II — FIXED COSTS FOR 20-MEGAWATT INSTALLATIONS

	NUCLEAR PLANT	COAL PLANT	OIL OR GAS PLANT
Investment cost	$1,709,000	$730,000	$504,000
*Annual investment cost	107,667 (6.3%)	62,400 (8.55%)	43,100 (8.55%)
Operation, maintenance & labor costs	150,000	84,100[1]	55,100[1]
Total fixed cost per million Btu (basis 80% load factor)	54c	30.6c	20.4c

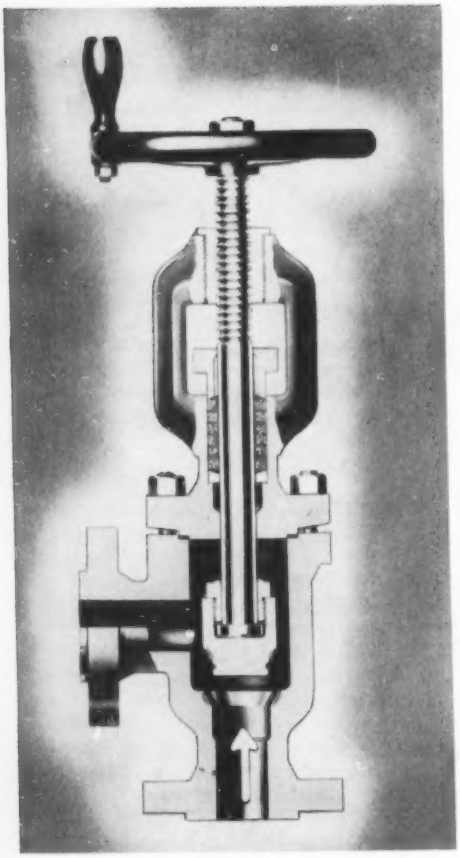
*Investment costs were based on 25-year amortization using sinking fund method with interest rate of 4%. A difference in rate occurs between nuclear and conventional plants (as noted by figures in parentheses.) For conventional plants, maintenance and fixed operating costs were computed on basis of percentage of investment cost. Items marked (1) represent labor costs only. When computing cost for nuclear plant, labor maintenance and fixed operating costs were grouped.

TABLE III — Total Fuel Cost for 20-MW Reactor at 80% Load Factor

	Cents per 10^6 Btu
Fully enriched fuel elements	48.8
Slightly enriched fuel elements (Plutonium credit of $12.00 per gram)	34.0
Slightly enriched fuel elements (Plutonium credit of $30.00 per gram)	23.0

TABLE IV — COMPETITIVE THRESHOLD
20 Megawatt Plants Operating at 80% Load Factor

	NUCLEAR			COAL			OIL OR GAS		
Total Fixed Costs	54c			30.6c			20.4c		
	Fully Enriched Fuel Elements	Partially Enriched Fuel Elements $12. Pu Credit	Partially Enriched Fuel Elements $30. Pu Credit	Zone A	Zone B	Zone C	Zone A	Zone B	Zone C
Total Fuel Costs	48.8c	34.0c	23.0c	60c+	50c+	40c+	60c+	50c+	40c+
Total Cost Per 10^6 Btu Delivered Heat	102.8	88	77	90.6	80.6	70.6	80.4	70.4	60.4



Foreign matter lodged between seating surfaces can prevent tight closure and cause damage from wiredrawing in hard seat blow-off valves

If you blow down boilers frequently you'll reduce valve troubles with this program of —

BOILER BLOW-OFF VALVE

E. E. **FINSEL,** Mechanical Engineer, Yarnall-Waring Company

BLOW-OFF valves, like many other pieces of boiler auxiliary equipment, are sometimes neglected. Perhaps this is due to the feeling that valves are rather self-sufficient items that require little or no care. While it is true that many valves around the boiler are rarely used, except for starting up and shutting down, blow-off valves often prove to be an exception.

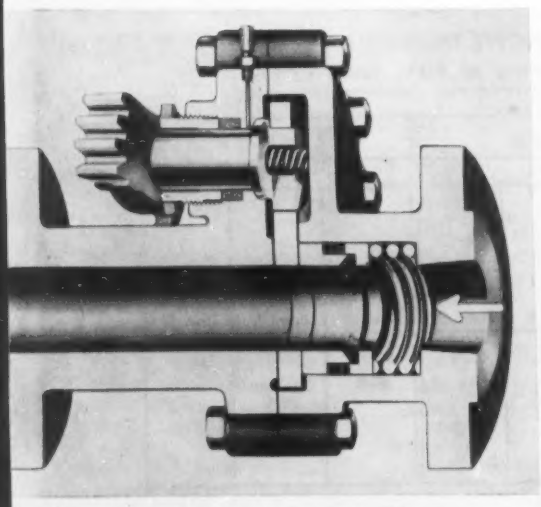
On many high pressure public utility boilers, which require very little make-up water, blow-off valves are rarely opened. But, boilers in some process industries, where the percentages of make-up water run high, are frequently blown down by hand. This procedure can result in undue wear of valve surfaces unless certain precautions are observed.

Difficulties encountered with blow-off valves are generally the same as those encountered with general purpose steam valves for the various pressures. These are: (1) mechanical wear between mating parts, (2) leakage due to improper seal of packing against moving component, and (3) leakage due to damage of sealing surfaces.

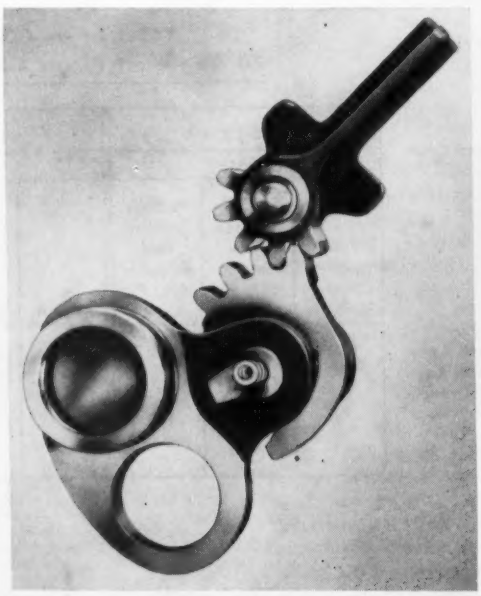
For simplification of discussion we have separated the following according to the various blow-off valve types; disc and seat, swing gate, and seatless.

Disc-and-Seat or Hard-Seat Type

Generally speaking, an adjustment is provided in this type for gland take-up to compress the packing and effect a seal around the stem. Strange as it may seem, many power plants do not take the necessary time to tighten the gland adjusting nuts. Leaks caused by this neglect, if allowed to continue, will ultimately cause erosion and corrosion of sealing surfaces. In some cases this can be severe enough to require actual valve body replacement. The obvious answer is to have someone responsible for keeping gland nuts tight.



Cross-section of swing gate type blow-off valve — with illustration of gear-operated sliding disc. Lapping action of disc tends to improve sealing in such valves



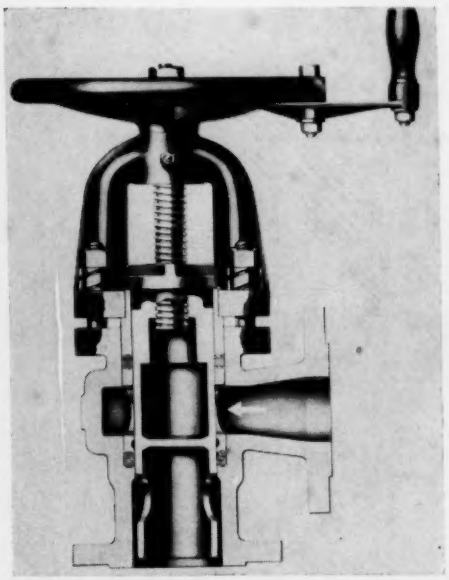
On seatless blow-off valves, upper packing gland leaks can be stopped by tightening yoke spring adjusting nuts

MAINTENANCE

Best way to determine whether a valve is leaking internally is to feel the pipe downstream. If it is hot, especially as one comes nearer to the valve, the valve is probably leaking internally. Be sure, however, that the heat is not coming from a downstream header or other source. In a disc-and-seat type valve the internal leak is probably caused by some foreign matter lodged between the seat and disc mating surfaces. When tightened, the jack action force of the handwheel may have caused this material to make an indentation in the seating surface, or the presence of the foreign matter which prevented tight closure may have allowed the seat to become wiredrawn. In either case it may be necessary to either disassemble the valve and lap in the disc to the seat, or to replace the damaged parts. If the seat is deeply scored or wiredrawn, some valve manufacturers have re-seating tools available for reconditioning the seat and thus saving necessity of body replacement. A new yoke gasket should be installed whenever the yoke-to-body joint is broken.

If the threads of the yoke bushing which mate with the stem become worn it is generally a sign of poor lubrication practices. Better made hard seat blow-off valves have lubrication fittings provided for this purpose. For a lubricant use a superheat mineral oil having a flash point of 600°F. Where no fitting is provided, lubricant may be applied directly to the stem threads immediately before blow down. This provides lubrication at the time when it is most needed.

Although many power plants use a "hicky" to increase leverage on valve handwheels, it is not considered wise. Unless a valve is in poor condition, it can generally be tightened satisfactorily by normal handwheel tightening. Excessive torques can cause stem bending and subsequent scoring which will materially reduce packing life.



Seatless type valves should be opened fully or closed tightly to prevent scoring of plunger tube and erosions of valve body

Swing Gate Type

Leakage around the stem of these valves usually can be prevented by tightening the stem packing gland. Where no externally adjustable stem packing gland exists and a leak appears, stem packing probably needs replacement.

If a double-tightening or swing-gate valve leaks internally usually the disc can be lapped-in to its seat with a fine grinding compound. Of course, complete disassembly is necessary. This, however, is seldom needed, since the motion of the sliding disc usually provides a lapping action during normal usage and the valve tends to seal even better after it is in service for some time. To assure a tight seal it is good practice to replace the body gasket whenever the body joint is opened.

Seatless Type

Leaks which occur externally at the upper packing gland on seatless valves are normally stopped by tightening the adjusting nuts which compress the yoke springs. These springs and nuts are designed to prevent leaks during operation of the valve or while the valve is open. Closure by pulling up hard on the handwheel forces the plunger head down on the gland for a tight seal.

Internal leaks in a seatless valve may be caused by a scored plunger tube or by an eroded groove in the body in the packing area. In either case packing life is materially reduced. Replacement of these components is essential. Prevention is rather simple if the valve packing nuts are kept tight and if the valve is opened fully and closed tightly each time it is operated.

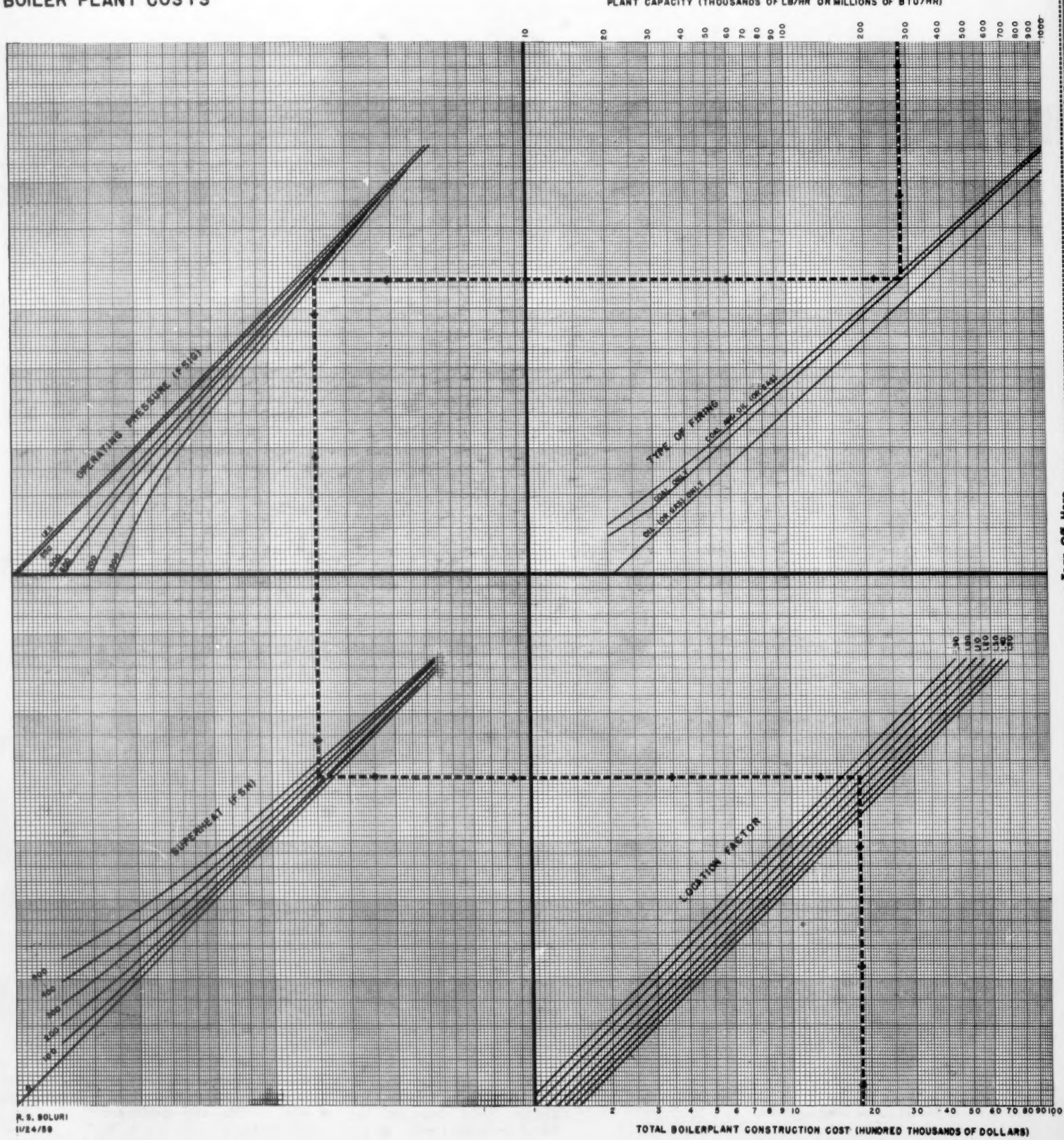
Throttling of all types of blow-off valves is not recommended, since repeated throttling can materially reduce service life. Where continuous blow is desired and a throttling type valve is required, conventional blow-off valves are not generally recommended. A valve designed specifically for that service should be installed. Many blow-off valve manufacturers have just such a valve for continuous blow-off duty.

Whenever valves are disassembled for inspection or repairs, new packing should be installed. If the valve has sealing gaskets in its construction, these also should be replaced with new ones.

Planned maintenance can help considerably to increase valve life and plant efficiency. The delegation of certain personnel to keep a watchful eye on all blow-off valves and periodically check on their performance, will help keep replacement costs and maintenance down. Prompt addition of new packing when it is obviously needed will prolong valve life. Regular lubrication will lengthen the life of valve components so that their in-the-line service can be extended. These seemingly small attentions can do much to keep blow-off valves from causing unnecessary down time.

Installation and maintenance instructions are usually furnished by blow-off valve manufacturers. These can be turned over to the operator to be hung near the equipment. Manufacturers know valve usage and can provide information, based on experience, which will provide best service and prolonged valve life. ■

BOILER PLANT COSTS



R. S. SOLURI
11/24/59

Tear Off Here

POWER PLANT COST CHARTS HAVE BEEN REVISED

JOHN W. BISHOP
Mechanical Engineer
Power Generating Section,
Bureau of Yards and Docks
U.S. Navy Department
and P&PSE Advisory Editor

Three years ago, this magazine first presented the popular POWER PLANT COSTS CHARTS devised and constructed by our advisory editor, John W. Bishop. To keep them up-to-date, revised location factors were published annually.

Many of our readers have written in asking if charts exist for higher capacities that were originally presented. To meet the requirements of our readers, Mr. Bishop has revised the charts, and we are presenting them here in large, workable form. Every year, a new set of location factors will be published which reflect the annual cost changes at any particular location

In the December 1956 issue (page 18) two graphs were presented for pre-design cost estimating of boiler plants and steam electric power plants. Location factors, provided with the original article have been presented in revised form in March 1958 (page 32) and March 1959 (page 29) to reflected escalated costs.

The original graphs were objectionable to a number of readers in that they were (1) too difficult to read for very small capacities and (2) did not extend to sufficiently large capacity plants. In order to reduce these objections, and effect certain cost change criteria, the following graphs have been revised and prepared in logarithmic form for boiler plant capacities up to 1,000,000 lbs/hr and electric generating capacities up to 100,000 kw.

The 1960 location factors (see table) presented herewith are for application to these new graphs, but may also be applied to the former graphs where desired.

The use of this cost estimating procedure may best be described by the following example:

A) Boiler Plant Example:

Capacity 280,000 lbs/hr; coal fired; operating pressure 900 psig. Boiler steam outlet temperature = 825°F total = 291°F superheat; location: Savannah, Ga.; location factor = 1.07 (from table). **Estimated boiler plant construction cost = $1,850,000**

Now if only this boiler plant were being installed, this would represent the total cost estimate for the plant.

If, however, the previously estimated boiler plant were to be used in conjunction with an electric generating plant, the second graph would be used for estimating the electric generating facility and the estimate thus derived would be added to the boiler plant estimate.

B) Electric Generating Plant Example:

Capacity — 23,000 kw
Throttle Press. — 850 psig
Throttle Temp. — 825°F
Type of Operation — Straight Condensing
Savannah Location = 1.07 Factor

Estimated Electric Plant (only) Construction Cost = $3,900,000

C) Total Power Plant Cost

Boiler Plant	**$1,850,000**
Electric Generating Plant	**3,900,000**
Total Power Plant	**$5,750,000**

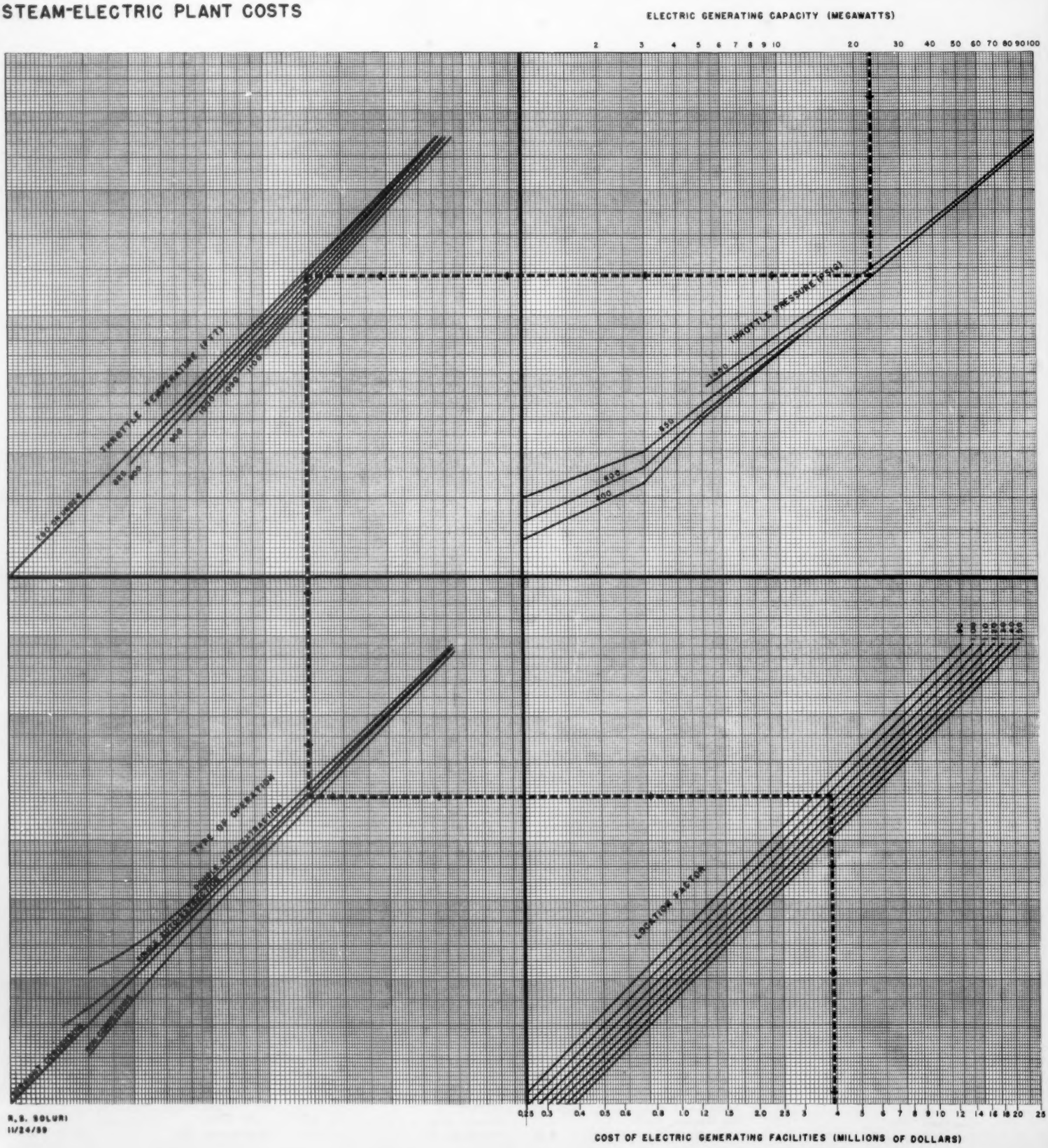
It should be remembered that estimates made by this procedure are of a **pre-design** nature for a plant representing, on the average, an optimum balance of initial construction cost and annual operating costs. Accuracies from 2-5% have been reported, but a ±10% accuracy is considered more realistic.

An "overdesigned" (or "gold plated") plant will generally cost more to construct, whereas a "skinned-to-the-bone" design will cost less to construct (but will often result in higher annual operating costs that quickly nullify any initial savings). ■

1960 LOCATION FACTORS

AREA	LOCATION FACTOR	AREA	LOCATION FACTOR	AREA	LOCATION FACTOR	AREA	LOCATION FACTOR
Albany, Schenectady, Troy, N.Y.	1.14	Dallas, Texas	1.20	Miami, Fla.	1.17	Rochester, N.Y.	1.17
Albuquerque, N.M.	1.26	Denver, Colo.	1.26	Milwaukee, Wis.	1.12	Rock Island, Moline, Ill.	1.13
Atlanta, Ga.	1.08	Des Moines, Iowa	1.20	Newark, Elizabeth, Jersey City, N.J.	1.28	St. Louis, Mo.	1.20
Baltimore, Md.	1.09	Detroit, Mich.	1.21	New Haven, Conn.	1.19	Salt Lake City, Utah	1.25
Birmingham, Ala.	1.05	El Paso, Texas	1.19	New Orleans, La.	1.12	San Antonio, Texas	1.14
Boston, Mass.	1.20	Houston, Texas	1.17	New York City, N.Y.	1.26	San Francisco, Calif.	1.28
Buffalo, N.Y.	1.15	Indianapolis, Ind.	1.13	Norfolk, Va.	1.09	Savannah, Ga.	1.07
Chicago, Ill.	1.18	Jackson, Miss.	1.08	Omaha, Nebr.	1.19	Seattle, Wash.	1.29
Cincinnati, Ohio	1.13	Jacksonville, Fla.	1.06	Philadelphia, Pa.	1.13	Spokane, Wash.	1.28
Cleveland, Ohio	1.20	Kansas City, Mo.	1.17	Phoenix, Ariz.	1.27	Springfield, Ill.	1.15
Columbus, Ohio	1.10	Los Angeles, Calif.	1.24	Pittsburgh, Pa.	1.13	Tulsa, Okla.	1.18
		Memphis, Tenn.	1.06			Washington, D.C.	1.15

STEAM-ELECTRIC PLANT COSTS

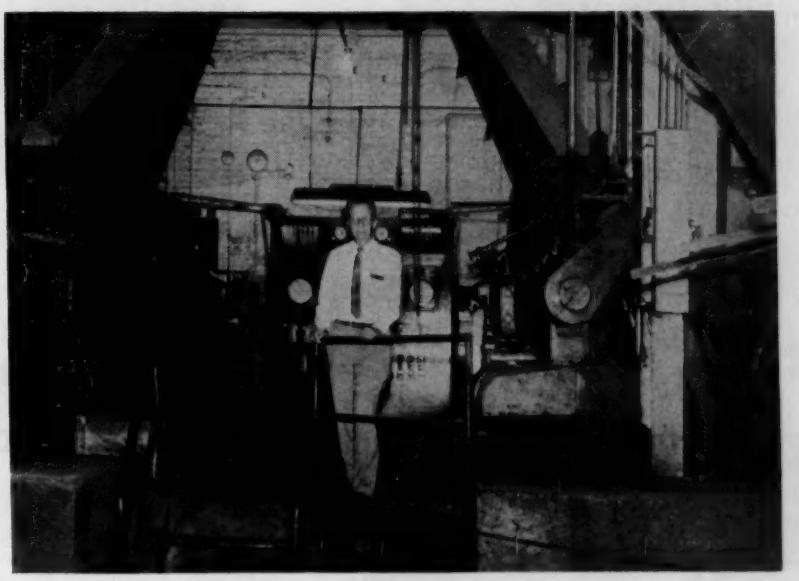

ELECTRIC GENERATING CAPACITY (MEGAWATTS)
2 3 4 5 6 7 8 9 10 20 30 40 50 60 70 80 90 100
THROTTLE TEMPERATURE (°F)
(40) 50 MEGS
850
900
950
1000
1050
1100
THROTTLE PRESSURE (PSIG)
1450
850
800
750
TYPE OF OPERATION
SINGLE INTERMEDIATE
LOCATION FACTOR
0.25 0.3 0.4 0.5 0.6 0.8 1.0 1.2 1.5 2.0 2.5 3 4 5 6 7 8 9 10 12 14 16 18 20 25
COST OF ELECTRIC GENERATING FACILITIES (MILLIONS OF DOLLARS)

R.S. SOLURI
11/24/59

Tear Off Here

To Keep The Ramblers Rolling Out

– C. E. Pflug, plant engineer for American Motors Kenosha plant, manages a department of 775 people



C. E. Pflug of American Motors, with two of the nine coal-fired boilers in the big "Rambler" plant at Kenosha

With automobile production at his plant having more than doubled in a year, C. E. Pflug, plant engineer at American Motors, has kept pretty busy supplying all the facilities for this fast moving operation. Major departments in the 110-acre Kenosha, Wis., plant include a foundry, forge shop, engine-, axle- and suspension-machining shop, press and body shop, and the main automotive assembly department. Mr. Pflug's department serves all these areas with a plant engineering group of 28 employees, a maintenance group of 512 employees, factory service with 214 employees, and the boiler plant with 21 employees.

Steam and Electricity

An average of 360,000 pounds of steam per hour is generated by the nine coal-fired boilers in the boiler house located at the edge of the plant area. Both high and low pressure steam are distributed for space heating and for manufacturing. A substantial increase in steam capacity is planned for the near future.

Electric power is purchased from the local utility at 26,400 volts. From this primary loop, radial distribution through the plant is 440 volts.

Twelve compressors supply pneumatic power at 100 psi for driving air tools, cylinders, and wrenches used throughout the manufacturing areas. Hydraulic power is generated and fed to various pieces of equipment.

Water at the rate of about 3,000,000 gpd is supplied by the Kenosha Water Dept. Only the boiler feedwater is treated. Sodium "Santosite" is used, with the boilers also being treated directly with phosphate.

Heavy emphasis is placed on proper ventilation in manufacturing areas at American Motors. Air-conditioning, however, is limited to a special room for cooling the IBM computers, and a few isolated areas. Three 15-ton units handle these requirements. Layout and maintenance of all the fluorescent lighting in the plant is handled by the maintenance department.

Beside these plant and power services, the Plant Engineering Department is responsible for the design, purchase, construction and maintenance of all plant buildings and of certain manufacturing equipment. This includes plant layout not only for the Kenosha plant but for American Motors plants in other locations.

Problem:
Maintenance of Electronic Controls

"One of the major problems that industry faces today is the maintaining of the equipment that has been developed and is being developed for today's high-speed production. Electronic control devices are a special problem since quallfied personnel is not readily available. Attempts by management to interest men in an apprenticeship in electronic field have not been altogether successful. Even contract maintenance, with its higher rates, has to be provided in certain areas to satisfy needs, at times," says Mr. Pflug. He now expects to hire electronic technicians to supervise maintenance of complex control devices.

Mr. Pflug has been with American Motors since 1939 and in his present position at the Kenosha plant since 1948. He is a graduate of the University of Nebraska, with a degree in electrical engineering. He is presently active in the National Society of Professional Engineers, the Welding Engineers Society, and the A.I.E.E., in which he is serving on two national committees. ■

NEW SOLUTIONS

for your plant and power services problems

Supplies high-pressure air; is compact, vibration free

The problem of supplying high-pressure air to its laboratory without installing heavy-duty stationary compressors has been solved by the Aeroquip Corporation, Jackson, Mich. The company is using a small, portable compressor which develops a maximum pressure of 6000 psig.

The unit is used to test hytings. It adequately handles draulic and air hoses and fitthis kind of job which requires small quantities of high-pressure air.

The compact unit is virtually vibration-free and requires little or no foundation.

(515-H compressor is product of Joy Manufacturing Company, Dept. P&PSE, Oliver Building, Pittsburgh 22, Pennsylvania.)

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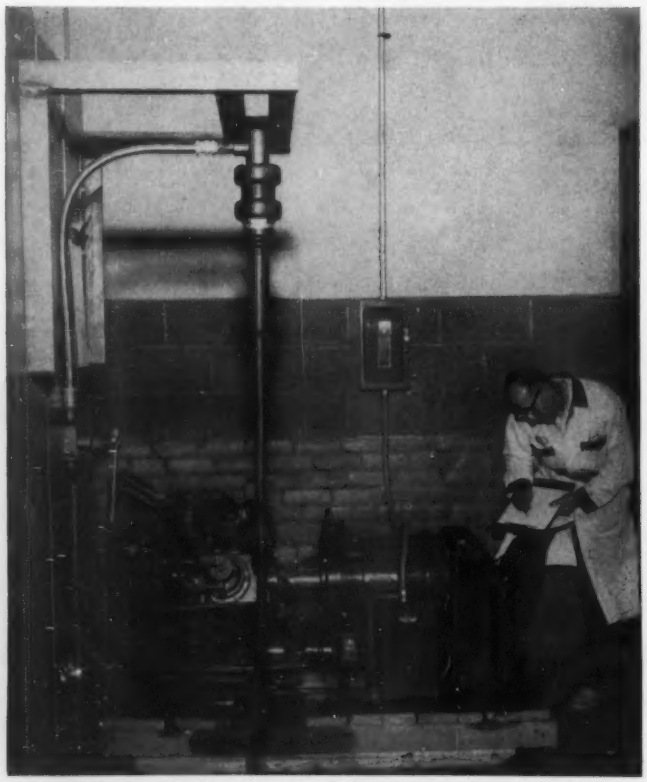
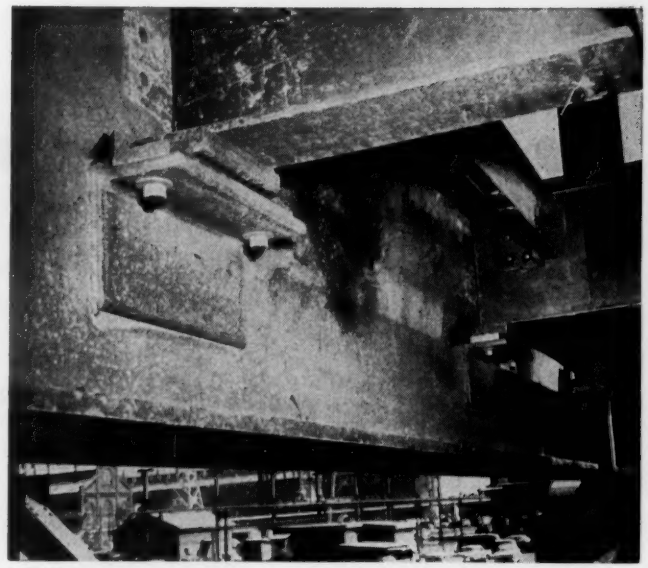


Compact compressor handles lab's requirements for small quantities of high-pressure air. Shown here skid-mounted, it will be permanently installed in the laboratory



Self-lubricating expansion plates (arrows) support all five decks of recently completed power station. The plates allow structural members to expand and contract easily in harmony with temperature changes

Cushions expansion, contraction shocks in building's structure

The recently completed Astoria Power Station at Queens, N.Y., is equipped with steel-backed, oil-impregnated porous bronze plates on all five tiers of the structure to allow members to expand and contract easily in harmony with temperature changes.

Offering built-in lifetime lubricity, easy installation, high corrosion and wear resistance, and long life, the plates feature a porous bronze structure impregnated with about 20% oil by volume. The plates soak up oil like a sponge absorbs water.

The lubricant is stored in myriads of tiny, interconnected pores which open to all areas of the plate surface. Unlike with solid bronze, no oil holes or grooves are required to deliver the oil to the loaded surface.

Impregnated with special non-gumming, weather-resistant oils, the plates can be installed on the footings of buildings and heavy equipment supports with little or no provision for maintenance.

Re-lubrication is seldom required. If desired, however, any hole or groove to any part of the plate surface will serve as an entrance for more oil.

Compressive strength of the plates is 15,000 psi. The high oil content, however, forms an effective hydraulic cushion that will withstand shocks and stresses many times the rated load-carrying capacity of the material.

Any number of plates can be combined to achieve desired load-carrying capacity. The plates are available in thicknesses ranging from ¼ to 1 inch; in widths from ½ to 12 inches; and in lengths ranging from 2½ to 24 inches.

Earlier experience with the plates shows that they are maintenance-free. After 13 years of service on a bridge, they have shown no wear nor required re-lubrication.

("Oilite" plates are product of Chrysler Corporation, Amplex Division, Dept. P&PSE, PO Box 2718, Detroit 31, Mich.)

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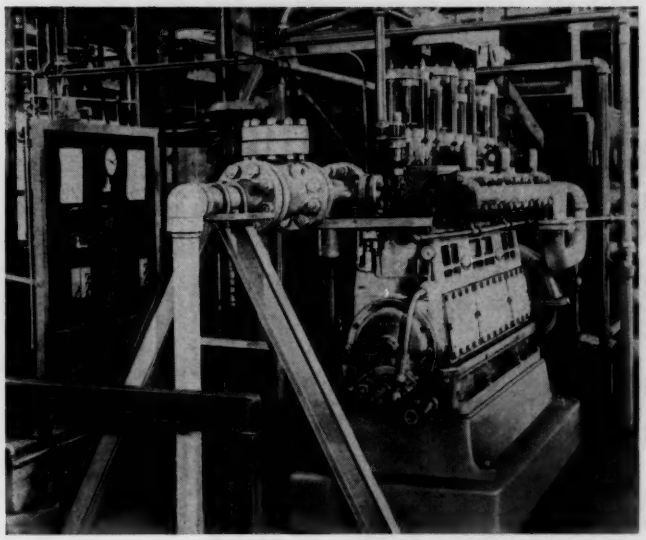

This 250-gpm pump handles water as a hydraulic pressure medium to give fireproof operation at possible lowest cost

Uses water as high-pressure hydraulic power fluid

A large midwestern die-caster recently turned a potentially hazardous condition into a safe operation and at the same time reduced production costs.

The company formerly used hydraulic oil pressure to power its die casting machines. Although it had never had an accident with these machines, a number of other manufacturers in the same field experienced bad fires. To avoid any chance of the same thing happening in its plant, the company ruled that only non-inflammable fluids could be used in the die casting machines.

Seeking safety at a good price, the company's engineers found a pump that could handle water as a high-pressure hydraulic fluid.

One of these pumps was installed on a trial basis and proved so successful that the company soon ordered three more. The four units are 2¼ by 5-inch, 1500-psi, gear-driven models equipped with 200-hp motors. They have a capacity of 250 gpm each.

The pumps have operated dependably 24 hours a day, seven days a week during peak seasons. Maintenance has been held to a minimum.

("Septuplex" pumps are manufactured by Aldrich Pump Company, Dept. P&PSE, Allentown, Pa.)

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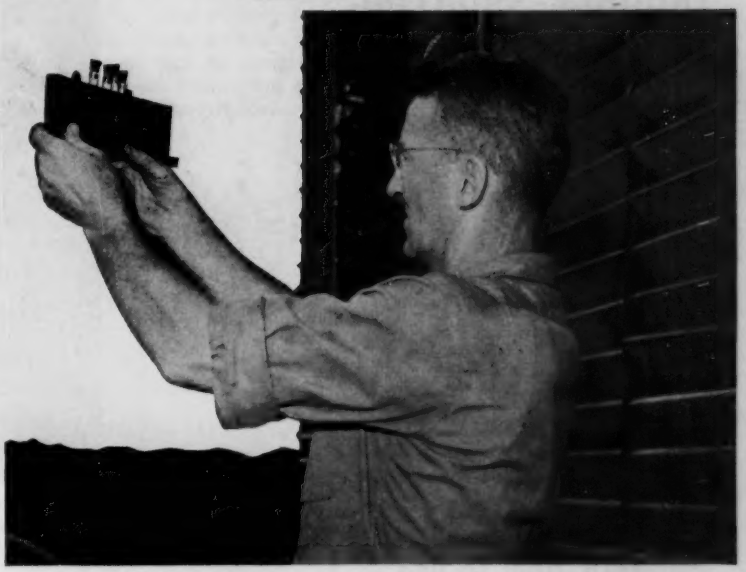
"All right . . . just one more, then I must get a picture of the valve!"

BIRD-ARCHER'S 8 POINT WATER TREATMENT PROGRAM



Designed for Inplant Testing... Performed by Your Personnel... Backed by Experts

If you use water for power, process or cooling, it will pay you to look into Bird-Archer's 8 point Water Treatment Service. Every step in this Service is performed by qualified chemists and engineers whose main task is to design a system that can be implemented by *your own personnel* and at the same time place at your disposal *60 years' experience* in solving water treatment problems.

Bird-Archer's 8 Complete Engineering Services

- Complete studies of your use of water or steam.
- Exhaustive analysis of water supplies starting at source.
- Modern laboratory with seasoned chemists specializing in water analysis and research.
- Operational changes where necessary.
- Custom formulated chemical treatments for your specific needs.
- Complete analysis of savings and benefits where additional equipment may be helpful.
- Instruction of your personnel by experienced technicians in accurate control and test procedures.
- Periodic call-backs by your Bird-Archer Service Engineer to be sure you continue to get the best possible results.

A Bird-Archer 8 Point Service Engineer is only a "phone's throw" away. Call him for greater peace of mind.

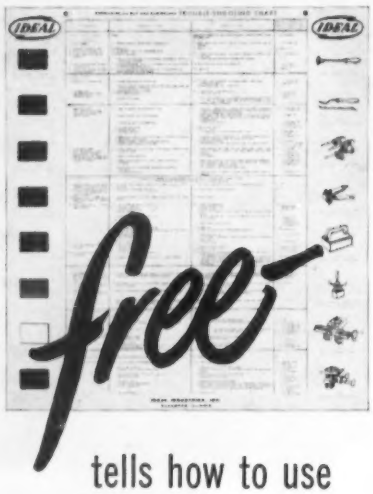
BA-000

BIRD-ARCHER
WATER TREATING CONSULTANTS
The BIRD-ARCHER Company, 4337 N. American St., Phila. 40, Pa.
New York • Chicago
The BIRD-ARCHER CO. of California, 415 Brannan St., San Francisco • Offices in Canada and Mexico

Circle 9242 inside back cover.

IDEAL

TROUBLE-SHOOTING WALL CHART



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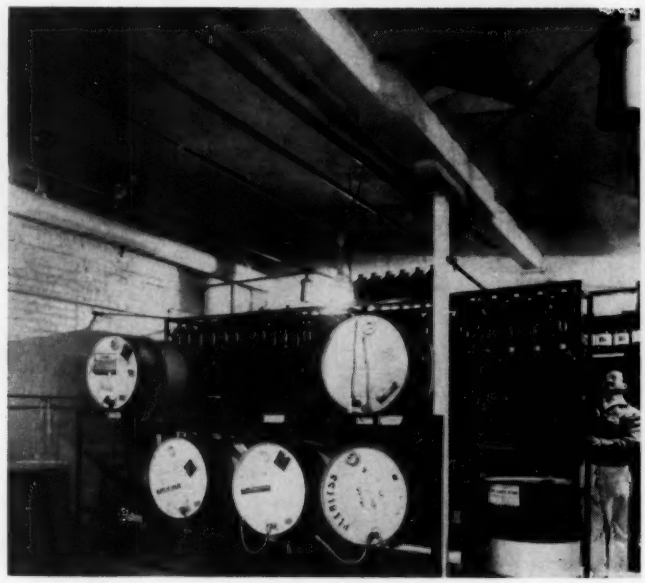


In the solvent storage room, an automatic carbon dioxide fire-extinguishing system has been installed. It is actuated by rate-of-temperature-rise fire detectors (one in protective wire cage, extreme top, to left of center) and discharged through Multijet nozzles

Effectively fights fires without damage to equipment

Carbon dioxide fire-extinguishing system will smother blaze in seconds

As part of an extensive fire safety and control program, Chas. Pfizer & Co., Inc., Brooklyn, N. Y., pharmaceutical and chemical manufacturer, has installed an automatic carbon dioxide system in the flammable solvent storage room and antibiotic recovery areas.

In case of fire in these areas, the rate-of-temperature-rise immediately causes detectors to trip nearby cylinders of carbon dioxide. Under its own pressure, the fire-smothering gas rushes from the cylinders through piping to Multijet nozzles.

It discharges in the hazard area in sufficient volume to reduce oxygen to a degree insufficient to support combustion. This will smother the blaze in seconds.

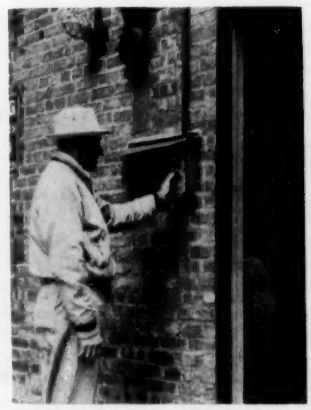
These systems have pressure-operated switches and trips built into the carbon dioxide piping network.

When actuated by the passage of gas they shut down forced draft ventilation and sound alarms.

Carbon dioxide is ideal for fires of this type. In addition to being an efficient fire extinguishing agent, it is an inert gas which cannot contaminate machinery or conduct electricity. Further, as it eventually dissipates into the atmosphere it leaves no mess to be cleaned up.

(Automatic carbon dioxide system was engineered and installed by Walter Kidde & Company, Inc., Dept. P&PSE, 675 Main St., Belleville 9, New Jersey.)

Circle 9244 inside back cover.



Outside, a small pull box (to left of operator's hand) provides a manual means of actuating the carbon dioxide fire extinguishing system

NEW DEVELOPMENTS

for

effective plant and power services operation

Dual spindle tool rolls up to 30 tubes per minute

Pneumatically operated tube expansion control unit features a double spindle design that greatly increases tube rolling capacity.

Tests of the unique tool show that it will easily roll up to 30 tubes per minute, depending on the speed of the motor used. This results in less strain on the operator with all tubes rolled to uniformly tight joints without leakage.

Dual unit automatically controls tube expansion by precise measurement of torque output and is accurate to .001 of an inch. This extreme accuracy is obtained through the sturdy, torque sensing cam mechanism which is completely unaffected by variance in air pressure.

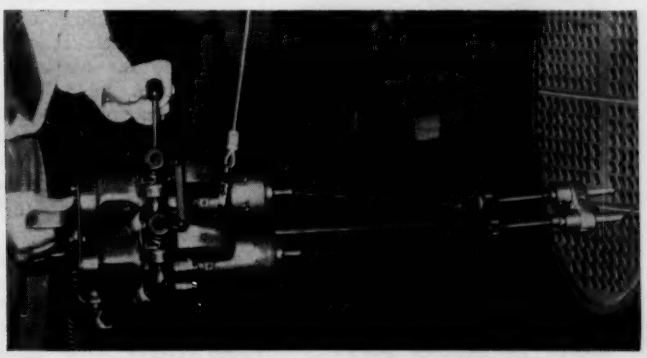
A finger-tip micrometer adjustment is quickly set to the desired torque without using any tool.

Calibrated ring permits setting as low as 0.5 foot pounds and up to 37 foot-pounds torque at 90 psi.

Air operation of the dual spindle rolling tool makes it very economical to use in rolling tubes ranging in size from ½" to 1". Unit operates at a speed of 1500 rpm, and can also be obtained in models that run in other speeds such as 700, 550 and 400 rpm. A supporting ring on the housing permits overhead suspension of the tool to relieve the operator.

(Dual spindle tube expansion tool is product of Aire-tool Manufacturing Company, Dept. P&PSE, Springfield, Ohio.)

Circle 9245 inside back cover.



Accurate to .001 of an inch on tubes from ½" to 1"

Light-weight compressor requires no lubrication, uses no diaphragms

Assuring maintenance-free operation, line of portable, oil-free, piston type air compressors eliminate lubrication and diaphragms that rupture.

Three models of 18-lb (including motor) portable compressor are available

The non-lubricated piston includes a specially compounded Teflon cup backed up by a silicone O-ring. Cylinder liner is made from corrosion-proof and wear-resistant 304 stainless steel.

Aluminum alloy ball seating against silicone in the check valve assures long life under adverse conditions. One of these units has been in continuous operation for over 18,000 hours, set at a 30 psi head with no lubrication and no decrease in pressure or efficiency of operation. Weighing only 18 lb — including motor — the compressor is self-contained, ready to plug into an electrical outlet to supply filtered air. Building up to pressure in seconds, this unit is available with an automatic safety bleed-off valve to release pressure in excess of pre-selected amount up to 100 psig. Motor is ⅛ hp, 115v AC (3 amps) induction type and is equipped with standard 8-ft heavy-duty, plug-in cord with thumb switch. The unit measures 10" long x 5¾" wide x 9½" high. Capacities range to 425 cfm at 100 psig.

The following special accessories are available, factory installed and adjusted: receiver tanks, pressure switches, pressure regulators, gages, relief valves, moisture traps, and air purifiers.

(Oil-free air compressor is manufactured by Winslow Manufacturing Corporation, Dept. P&PSE, 3695 East 10th Court, Hialeah, Fla.)

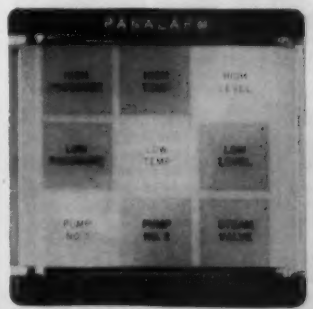
Circle 9246 inside back cover.

Miniature annunciator has no moving parts

Economical, solid state, miniature annunciator has longer life and greatly decreased maintenance because there are no moving parts. All operational functions are performed by highly derated solid state elements.

Low energy control circuits and negligible inductance provide intrinsic safety. Ignition in hazardous atmospheres is impossible because no arc can be sustained. All Class I, Division II requirements are greatly exceeded; there are no make or break contacts.

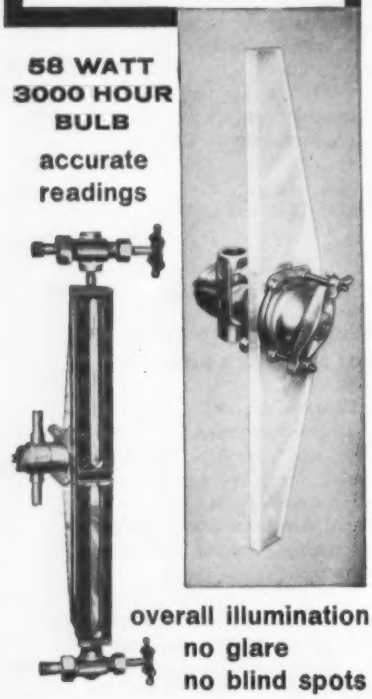
The annunciator operates on standard AC or DC line voltages; no transformer power supply is required. Operation is not affected by normal line variations or surges. Continuous duty is maintained at ± 20% nominal voltage. Lamps



Intrinsically safe, easily expandable

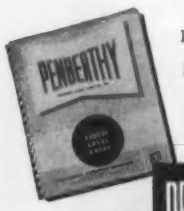
To next page

NEW!
PENBERTHY ILLUMINATORS
for Liquid Level Gages



Faster, more accurate liquid level readings are provided by Penberthy's new, improved, explosion-proof, dust-tight illuminators. 58 Watt Bulb (with medium screw base) gives higher light intensity for 4-times the life of ordinary illuminators. Exclusive rugged aluminum housing over bulb extends bulb life, offers better protection and simplifies relamping. Clear plastic wedge diffuses light over entire length of gage glass.

Illuminators are easily installed on present or new gages. Available in single or double sections, they are used in combination for gages with 3 or more sections. Approved by Underwriters' Laboratories for Class 1, Group C and D hazardous locations.



For further information on Penberthy Illuminators, liquid level gages and valves, write or phone. Ask for Catalog #36.

PENBERTHY

PENBERTHY MANUFACTURING CO.
Division of Buffalo-Eclipse Corporation
Prophetstown, Illinois

Circle 9247 inside back cover.

From preceding page

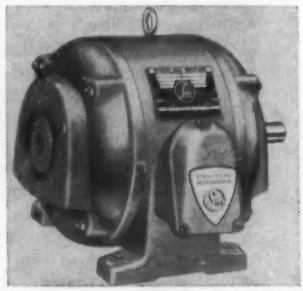
are interchangeable with existing annunciators. Models of this system can be expanded easily due to interchangeable plug-in units. Momentary field contact operation of 0.5 milliseconds is sufficient to lock-in the system and avoid alarm loss.

Unit can be supplied to fit a 5" x 5" or 6" x 6" standard pneumatic or electronic instrument case or any standard annunciator cabinet.

(Annunciator is development of Panellit, Inc., Dept. P&PSE, 7401 No. Hamlin Avenue, Skokie, Ill.)
Circle 9248 inside back cover.

Drip-proof motors have extra shielding

Development in standard, drip-proof motors permits their use with full overload characteristics on many demanding applications, such as food processing, chemical, oil-well pumping, car washing.



In ratings from ½ to 50 hp

Motors are designed to operate under adverse conditions of continuous and excessive moisture, high humidity and temperature, salt spray, dust, oil, and chemically contaminated atmospheres that previously required totally enclosed fan-cooled protection.

Flexible insulation is achieved by multiple application and controlled processing of a special silicone sealing compound. Insulation is thin, non-porous, yet permanently resilient and flexible. It will not chip, crack, peel, nor separate under extreme temperature. Its superior heat dissipation allows smaller ratings to be used.

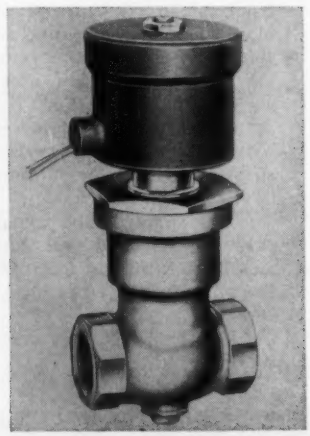
Motors have herringbone rotor design for quiet motor operation and completely sealed bearings for positive protection. Terminal box is sealed with a neoprene gasket and neoprene diaphragm seal. Lead wires are neoprene insulated. Rotor and fan are sprayed with an anti-corrosion coating.

Motors are available in all ratings from ½ hp to 50 hp, any phase, frequency or voltage, torque or slip characteristics, and with multi-speed winding.

(Drip-Proof Motors are development of Sterling Electric Motors, Dept. P&PSE, 5401 Telegraph Road, Los Angeles 22, Calif.)
Circle 9249 inside back cover.

Solenoid valve is full-ported

Direct-lift solenoid valve features a solenoid that assures positive, reliable operation regardless of line pressures within its capacities of zero to 3000 psi.



Solenoid gives positive operation regardless of line pressures

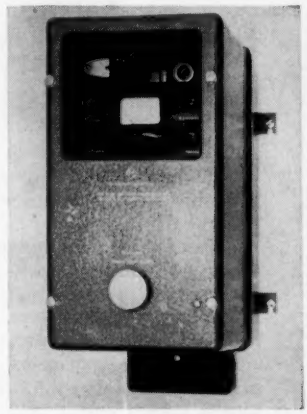
Full-ported design is available with port sizes from ¼" to 3". Valves can be of bronze or stainless steel.

(Solenoid valve is product of The Atkomatic Valve Co., Inc., Dept. P&PSE, 545 West Abbott, Indianapolis, Ind.)
Circle 9240 inside back cover.

Protects steam turbines from excessive speeds

From West Germany comes a monitor that provides a means for accurate and very fast protection of steam turbines from excessive speeds.

It works in this way: If in the case of turbo-generators, the load is suddenly greatly reduced or dropped altogether, then danger will generally occur with an inadmissible increase in speed. This calls for a suitable protective device.



Monitor will respond immediately to increase in angular acceleration of steam turbines

For this reason, a protective device should operate in conjunction with a monitor which is responsive to the angular acceleration and is, therefore, fast-acting.

As a rule, the angular acceleration upon a sudden load reduction is between 5 and 30% per second, dependent upon the type of turbine and the initial load.

To meet this requirement, the monitor employs a tachogenerator which is directly coupled to the turbine shaft and delivers an AC voltage whose frequency is strictly proportional to the rpm which it follows without inertia.

The generator is selected to produce 600 cps at turbine speeds of 3000 rpm.

A discriminator provided in the overspeed monitor changes the frequency derived from the monitor into a proportional voltage. After differentiation, a DC voltage is ob-

tained which represents the rate of change of the turbine speed.

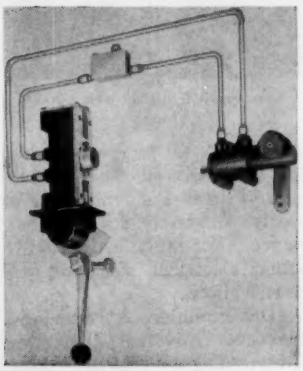
If this exceeds a given limit, then an electronic circuit makes a normally closed relay drop. The relay contacts, that may be connected as desired for the output signal of the set serve to excite magnet type valves or similar devices which aid to reduce the steam supply.

The power needed to operate the monitor (valve heating, etc.) is also taken from the tacho-generator. Thus being independent of external power supplies, the set is extremely dependable.

(Type FDW Overspeed Monitor is available from Rhode & Schwarz Sales Co., Inc., Dept. P&PSE, PO Box 275, 111 Lexington Ave., Passaic, N.J.)
Circle 9251 inside back cover.

Remote control system has vernier lock for precise positioning

Remote control system with newly developed vernier lock is a manually operated, hydraulic linkage for accurately positioning, controlling and duplicating movement at a distance.



Manually operated device accurately positions, controls and duplicates movement at a distance

It is used for control of valves, clutches, brakes, throttles, transmissions, feed mechanisms and engines.

With the vernier lock, the master unit lever is moved to the approximate location and locked into position. The vernier adjustment then permits precise lever travel of plus or minus 5 degrees for applications requiring very accurate positioning.

Master units are also available with the lock only.

(Remote control system is manufactured by Hydronic Corporation, Dept. P&PSE, 12685 Arnold, Detroit 39, Mich.)
Circle 9252 inside back cover.

Quick-cleans motors and electrical equip

Chemical solvent in spray can is said to completely clean electrical motors and plant equipment of oil, grease, dirt, dust and other materials.

Solvent will also "demoisturize" equipment which has been short-circuited by water.

Spray can utilizes a special nozzle which provides a long-range, concentrated drenching spray to flush off undesirable foreign materials.

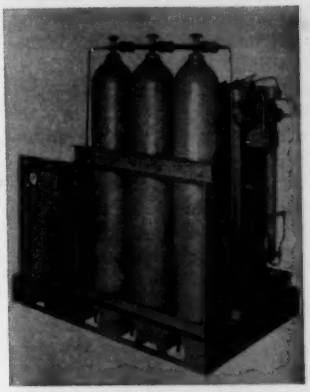
Cleaner is non-combustible, and will actually extinguish a flame if sprayed on it. It is non-toxic and non-corrosive and will not stain or corrode metals and will not attack paint.

(Solvent cleaner is manufactured by Montgomery Chemical Company, Dept. P&PSE, Jenkintown, Pa.)
Circle 9253 inside back cover.

Pneumatic facility is completely packaged for making tests

For testing pneumatic system components, a compact, skid-mounted, high-pressure pneumatic facility delivers clean and dry compressed air at pressures to 5000 psi and −65°F dewpoint. It is used in conjunction with a pneumatic test bench or control station.

The facility is equipped with a 5000-psig, 15 scfm compressor designed with automatic blowdown and automatic start-stop. The automatic air dryer has an oil-vapor prefilter and entrainment separator, and a 25-micron afterfilter.



Package includes compressor, storage bottles, manifold, air dryer, piping, instrumentation

Also included in the package is a high-pressure manifold and a bank of three 1½ cu ft, 6000-psi storage bottles, plus all necessary piping, instrumentation and safeguards.

Air from the receivers can be cascaded into the main manifold for high flow rates at elevated pressures, or single receivers can be selected for low flow rates and proof testing.

(Model KC-1159 pneumatic facility is product of Kahn and Company, Inc., Dept. P&PSE, PO Box 516, Hartford 1, Connecticut.)
Circle 9254 inside back cover.

Protects motors against overloads, adjusts for demand

A limiting device, engineered to provide positive protection against motor overload and featuring an adjustable demand limiter, is designed for use with pneumatic control systems. The device is intended for application to all types of centrifugal refrigeration compressors, but can be used on pumps, fans and electrical heating installations.

Installed in the pneumatic control circuit and responding to motor current, it limits the

To next page

If you have
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in
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✓ Water Softening
✓ Filtration

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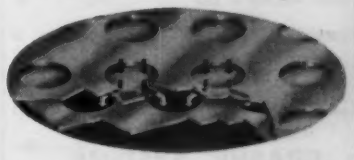

Whether it's treating feed water for steam boilers or recovery of high purity water for your industrial processes—your ion exchange, demineralizing or filtering equipment can be greatly improved by installing "Neva-Clog."

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Circle 9255 inside back cover.

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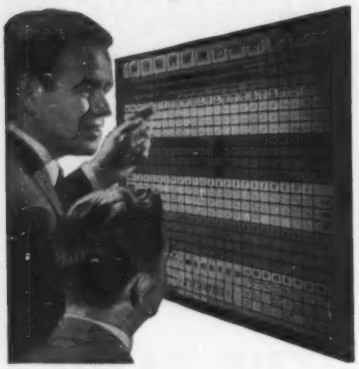

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From preceding page

opening of the capacity-regulating inlet valve or dampers to maintain a predetermined maximum motor current regardless of the demands of other controllers.

Feature of the relay is a remotely located manual adjuster for limiting the motor current to any selected value between 40 and 100 percent of the maximum.

Designed to operate on any current between 3 and 7 amps, it can be applied to motors of any size when used with a properly selected current transformer. The secondary winding of the current transformer energizes the coil of the relay which in turn activates a conventional pneumatic relay to vary the output pressure in inverse proportion to the current.

Maximum motor current is established by an integral set point adjustment.

A supplementary winding on the relay coil provides the demand limiting feature. This potentiometer, with dial graduated from 40 to 100%, may be located at any convenient location.

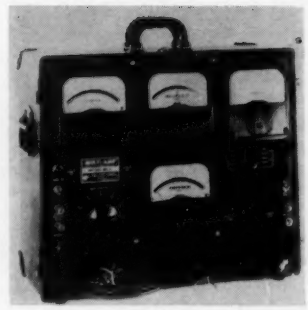
(R-27 load limiting relay is product of Johnson Service Company, Dept. P&PSE, Milwaukee 1, Wis.)
Circle 9257 inside back cover.

Indicating instrument calibration set

Portable, compact test unit for calibrating ammeters, voltmeters, and other indicating instruments is designed for service in the field, and in the laboratory.

In application, calibration is by comparison with four instruments serving as standards of pre-determined accuracy and by a separate power source, all included in the set.

Unit consists of four output circuits to provide the currents and voltage for instrument calibration. Instruments in the set include a 2.5/5/10/25/50-amp AC ammeter, a 250/500-volt AC voltmeter, a 250/500-volt DC voltmeter,



Calibrates ammeters, voltmeters, indicating instruments

and a 0-100 millivolt DC millivoltmeter.

All output circuits have a full-load rating for one-hour duty cycle, and up to 400% load for 10 sec. Each output is adjustable by coarse and vernier autotransformers. Required output is selected by a switch which acts also as a range switch. Thus only one output circuit may be used at one time.

(Calibration set is development of Multi-Amp Div., Multi-Amp Electronic Corp., Dept. P&PSE, 465 Lehigh Ave., Union, N.J.)
Circle 9258 inside back cover.

Protects bearing area from tramp metal, other abrasives

One of the newest uses for glass-filled nylon is in the manufacture of cages for either roller or ball bearings.

Available in a wide range of sizes, this type of construction forces tramp metal invading bearing area to imbed itself into the plastic. This removes loose metal particles from circulation and greatly reduces bearing abrasion and consequent wear of adjoining metal surfaces.

If the bearing cage should fail, the problem of metal particle entrainment is obviated.

Assembly time and initial material cost savings are features of this material. Molded-in retention cavities firmly position and hold round or shaped bearings, which are simply popped into the receptacles.

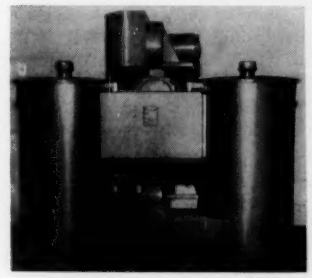
The material has excellent wear resistance, and, in itself, requires no lubrication. These properties together with a wide temperature service range assure smooth, unhampered operation and greater bearing life.

(Glass-filled nylon bearing cages are manufactured by The Garlock Packing Company, Dept. P&PSE, 442 Main Street, Palmyra, N. Y.)
Circle 9259 inside back cover.

Package dehumidifier has high capacity

Completely automatic, self-contained adsorption dehumidifier has high capacity adsorption and reactivation systems, and efficient high flow-low flow transfer valves. Unit handles as much as 700 cfm and can remove 300 lbs of water in 24 hours.

With a minimum of moving parts and thermostatically protected heaters, the dehumidifier is designed for long



Removes 300 lbs of water in 24 hours

life and trouble-free operation. Filters and motors are easily accessible for maintenance. Unit may be used with either electrical, steam or gas reactivation.

(Dehumidifier is development of Universal Dynamics Corp., Dept. P&PSE, Box 9814A, Arlington 9, Virginia.)
Circle 9260 inside back cover.

For more information on items reported in the New Developments section circle corresponding numbers on reader service card opposite back cover.

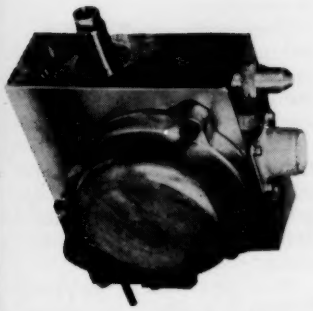
Universal electric governor has high sensitivity

Unit improves speed regulation on engines and turbines

Constant speed control over a 10 percent range in 400 cycle service, and over a 30 percent range in 50/60 cycle service is provided by electrical frequency sensing governor.

Sensitivity and response characteristics of the governor are measured in milliseconds with the frequency circuit operating within three milliseconds of the time that even the smallest speed change occurs. Full movement of the throttle from closed position to open position (and vice versa) is accomplished in 0.035 seconds.

In addition, the high sensitivity of the governor improves the speed regulation of slower speed engines under 720 rpm.



Electric control unit (left) is sensing element of the electric governor; it mixes and amplifies signals. Summation of these variables is magnetically amplified and the resulting error signal is applied push-pull across the hydraulic actuating unit (right).

Transducer (differential transformer) element, which replaces the wire-wound feedback potentiometer, gives increased service life since there are no exposed wires or forced rubbing contacts.

Unit is made in standard design universally adaptable to prime movers of any make or model.

It does not require motor operation of the frequency reference potentiometer for remote control. A manual frequency reference potentiometer can be installed as far as 250 feet from the electric control for remote adjusting of frequency output.

An accurate and sensitive speed drive accessory in the engine is not required as with conventional hydraulic governors.

(Model EFG governor is development of Westinghouse Electric Corporation, Dept. P&PSE, PO Box 2099, Pittsburgh 30, Pa.)
Circle 9261 inside back cover.

Stops floor corrosion in power plant deionizer rooms

Specially formulated materials protect concrete floors against corrosion caused by spillage of acids and caustics in power plant deionizer rooms. Use of these materials will enable power plant operators to eliminate routine painting or repairing of concrete floors.

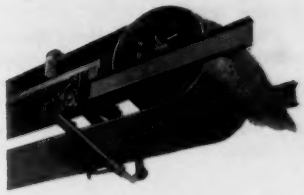
Composed of thermosetting resin, a hardening agent and a special aggregate, the material sets up fast to accommodate normal traffic within 24 hours after application. Applied over existing floors in ¼" thicknesses, it is practically impervious to impact

The material is available in green, red, gray, black or in a special terrazzo effect.

("Corocrete" is product of The Ceilcote Company, Dept. P&PSE, 4832 Ridge Road, Cleveland 9, Ohio.)
Circle 9262 inside back cover.

Spring type cleaner protects conveyor belts

Originally developed to clean wet, sticky coal and ore from high speed conveyor belts, spring type belt cleaner has proven the efficiency, dependability and economy of this type of cleaner in widely diversified installation applications.



Available for any width belt

Belt cleaner gently removes material which adheres to the returning belt and would otherwise be ground into the belt by snub pulley and return rollers. This action eliminates messy dribble, accumulation of material on return rollers and caking build-up on snub pulleys which cause dangerous belt stresses. Belt life is increased, since there is no abrasive action of a dirty belt passing over snub pulleys and return rollers.

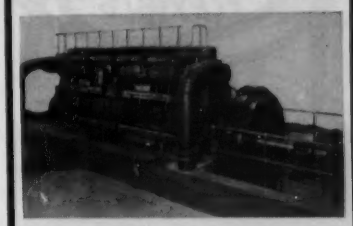
Cleaner consists of a row of thin, spring steel wiper blades, each with an individual pressure spring. Wiper blades are set perpendicular to the belt surface, but diagonal to travel of belt. Pivoted connections between blades and springs permit wiping edges of blades to seat uniformly on the surface of the returning belt. As the belt passes over the spring cleaner, each blade wipes a path clean and dry. Since blades overlap, the entire carrying surface is wiped clean and free from dirt and slime.

No moving parts and no power drive are required, which makes belt cleaner easy to install and economical to operate.

(Belt Cleaner is product of Stephens-Adamson Mfg. Co., Dept. P&PSE, Ridgeway Ave., Aurora, Ill.)
Circle 9263 inside back cover.

DIESEL ENGINE GENERATOR SETS

Immediate Delivery from Inventory!



Any voltage; 50 or 60 cycle. Available in stationary, mobile or portable model. Following listing is only partial.

1420 kva Fairbanks-Morse model 38D—8⅛ (photo above)
1375 kva General Motors model 278A
1250 kva General Motors model 567
938 kva General Motors model 567
625 kva General Motors model 278A
625 kva American Locomotive Co. model 539
412 kva Worthington model CC
375 kva General Motors model 268A
312 kva General Motors model 268A
250 kva General Motors model 268A

A. G. SCHOONMAKER Company, Inc.

Foot of Spring St., Sausalito, Cal. Edgewater 2-1490
50 Church St., New York 7, N. Y. Digby 9-4351

Circle 9264 inside back cover.

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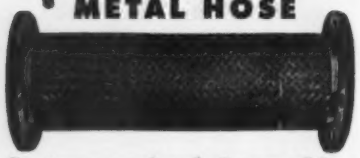
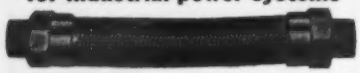
Circle 9265 inside back cover.

COBRA FLEXIBLE
SEAMLESS METAL HOSE



Custom constructed assemblies for industrial power systems



All sizes in bronze, stainless or carbon steel, monel, inconel and low carbon nickel. Seamless spiral or parallel corrugation... Braided. All type of fittings and flanges welded, brazed or soldered. Also, interlocked hose.

write — wire — phone: RE 7-3311
...for prices and catalogs

COBRA METAL HOSE
5059 S. Kedzie Ave. • Chicago 32, Ill.
Circle 9266 inside back cover.

CONSIDER THE HAZARD

A conversion burner or stoker in a riveted HRT boiler can cause the girth seam to deteriorate quickly. This is due to the direct impact of intense heat upon the lapped edge of the plate.

The wise thing to do before converting is to insulate the seam with a National Seam Protector. It's a precaution which will surely save a lot of trouble and expense.

Our seam protectors have saved hundreds of HRT boilers during the past 37 years. You'll find the facts interesting and valuable. Write for literature now while you're thinking of it.

NATIONAL BOILER PROTECTOR CO.
928 REIBOLD BLDG. • DAYTON 2, OHIO

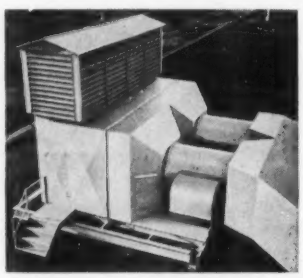
Circle 9267 inside back cover.

Packaged unit supplies warm air at 150,000 cfm

Called the largest of its kind, direct-gas-fired packaged unit is designed to supply 150,000 cfm of replacement air in plants that are air-starved due to evacuation by exhaust systems venting fumes, gases and solid particles.

Air intake is from a four-direction louver tower giving ample air supply no matter what the wind velocity or direction is. Motor-actuated dampers seal off ceiling air intake in combustion chamber and open when gas burner ignites.

Pushbuttons on factory floor control start and stop of operating cycle. Otherwise unit operates automatically to supply warm air.



Compact roof-mounted packaged unit supplies 150,000 cfm of warm, make-up air to industrial plants

A premix 15-million-Btu gas burner with stainless steel baffle wings, that protect flame and disperse heat into air stream, automatically adjusts to control flame in direct relation to temperature changes.

Two 40-hp low-velocity axial fans pull air through the combustion chamber into plenum and distribution chamber where over 100 individually adjustable 3′ by 5′ registers disperse the warm air.

A complete line of these units, down to 4000 cfm, is available.

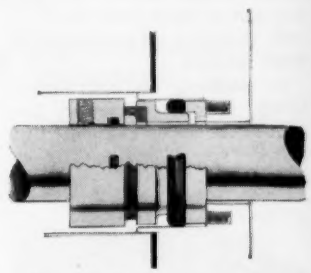
(Direct-gas-fired packaged units are manufactured by Metals Engineering and Manufacturing Co., Inc., Dept. P&PSE, 8820 Lyndon, Detroit 38, Mich.)
Circle 9268 inside back cover.

Size of unit is dramatically illustrated in this view of the register chamber interior. Only half of the chamber is visible in this view which shows dozens of adjustable registers used to regulate flow of heated air into plant

Pump seals operate on balanced fluid pressure alone

Simple, reliable seal gives positive and durable sealing by using balanced fluid pressure to replace operational springs, which are employed only to keep the deep carbon faces in contact when pump is shutdown or pressure reduced below operational level.

With this seal, the use of



Use of hydraulic pressure eliminates need for spring closing

hydraulic pressure eliminates need for spring closing. Excessive and uneven face wear is eliminated.

The usual complicated conventional complex rotary mass is replaced by a single ring cutting down excessive stuffing box turbulence.

Designed for easy installation by maintenance men, one standard design is used for all pressures. No sleeve or shoulder is required for high pressures.

This springless sealing method is available for widest range of corrosive or other service fluids.

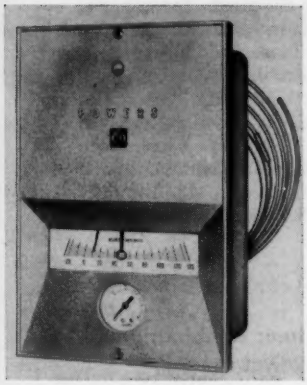
(CounterPoise seals are manufactured by A. W. Chesterton Company, Dept. P&PSE, 6 Ashland St., Everette 49, Mass.)
Circle 9269 inside back cover.

Pneumatically controls remotely readjusted temperatures

Submaster regulator gives accurate control of remotely readjusted temperatures in heating, air conditioning, and industrial processes.

Device is a pneumatically operated temperature control-

ler whose control point is reset by a master controller or positioning switch. Master may be a thermostat, hygrostat, pressure regulator or manual positioning switch. Submaster regulator has throttling range adjustment of 0 to 35 per cent. Gas-filled thermal system is unaffected by cross ambient bulb and capillary temperatures. Need for bulb elevation correction is eliminated.



Control point of submaster regulator is reset by master controller or switch

Direct action and reverse adjustment can be readily converted.

Unit is compact, has large easy-to-read scale, and consumes minimum amount of air.

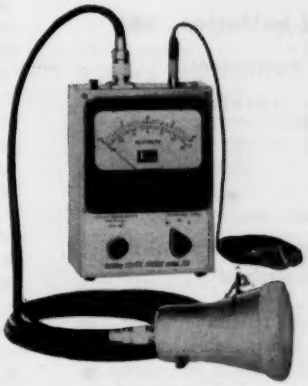
(Series 200 submaster regulator is manufactured by The Powers Regulator Company, Dept. P&PSE, 3434 Oakton St., Skokie, Ill.)
Circle 9270 inside back cover.

How to measure static charge easily

Electrometer voltmeter is designed to measure static charge voltages easily and accurately. Up to 100 kv can be measured with the detecting head operated at a distance of six inches from charged surface.

The device features a sensitive detecting head and low-noise connecting cable. Full scale ranges are 10kv and 30kv when the detecting head is brought approximately ⅜" from the charged surface.

With an accuracy of 5%, device features portable bat-



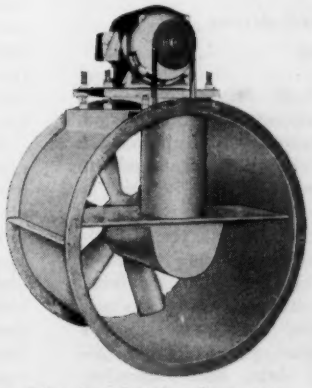
Meter reads static charges — both positive and negative — up to 100 kv

tery operation, indication of both positive and negative voltages, and a convenient carrying case.

(Model 250 Static Meter is product of Keithley Instruments, Inc., Dept. P&PSE, 12415 Euclid Ave., Cleveland 6, Ohio.)
Circle 9271 inside back cover.

For corrosive areas — fiber-glass duct fans

Available in 12, 16, 20, 24, 28 and 36 inch diameters, line of fiber-glass duct fans under many conditions offer resist-



Fiber-glass duct fans have stainless steel drive shaft and hardware

ance to corrosion equal to or exceeding that of corrosion-resistant metals.

The pneumatic lift is a simplified method of lifting oil from the reservoir to the perforated oil distribution plant, which in turn distributes the oil to the pads. No special protection is needed for hazardous locations.

Other changes in the unit include a new cleanout door for easier maintenance, the addition of a bullseye gage to observe and help control the oil level in the unit, and the elimination of studs sticking out of the top of the unit.

(Model "C" PO1 Type Cycoil air-bath air cleaner is manufactured by American Air Filter Company, Inc., Dept. P&PSE, 215 Central Avenue, Louisville 8, Ky.)
Circle 9272 inside back cover.

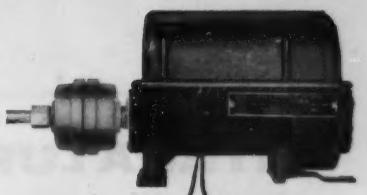
Quick and easy . . .

. . . replacement of butterfly valve is possible with this cartridge type unit consisting of a standard butterfly valve in a wedge-shaped body. This body is inserted in the outer body and held with the cover.

If necessary, the wedge-shaped insert can be removed without disturbing the line flanges or the piping. The cover of the valve and the shaft extension accommodate standard operators.

The valve's flow characteristics are identical to that of the standard two-flange valve.

(Cartridge type butterfly valve is product of Allis-Chalmers Manufacturing Company, Dept. P&PSE, Milwaukee 1, Wis.)
Circle 9273 inside back cover.



Let Speed Measurements Help You

Let the Esterline-Angus Speed Recorder System provide you with records that will help you

- **determine production rates,**
- **control product quality,**
- **check performance of equipment and machinery,**
- **establish operator efficiency and safety.**

All you do is connect the shaft of the E/A Tachometer Generator (above) to any equipment whose speed you want to measure.

The Tachometer Generator actuates an E/A strip-chart Speed Recorder (below) giving you an accurate, permanent, indisputable record.

There's no end to the applications of the E/A Speed Recorder. For instance, in continuous manufacturing operations, such as paper and steel production and annealing and baking processes. They're also used for such things as measuring lost time, the flow of liquids or gases, and in time studies on machinery which is stopped and started between operations.

You'll find many other applications described in Bulletin 260. Ask for a copy or for an E/A specialist to call.

The Esterline-Angus Company

No. 1 in fine Graphic Instruments for more than 50 years.

DEPT. M, P.O. BOX 596, INDIANAPOLIS 6, INDIANA

Circle 9274 inside back cover.

NEW LITERATURE

for effective plant and power services operation

Reviews of books and industrial bulletins describing equipment, supplies, services

Thermal insulation catalog has all

Fifty-four page catalog describes thermal insulations for all types of commercial and industrial requirements, in applications ranging from —400°F to 3000°F.

There are six complete sections, each devoted to a specialized group of thermal insulations. These include industrial and high temperature; plumbing, heating, and air conditioning; refrigeration; insulating firebrick and refractories; finishes and weatherproofing materials; and miscellaneous insulations, including asbestos papers, millboard, felts, blankets, and similar products.

(Catalog IN-244A is issued by Johns-Manville Corporation, Dept. P&PSE, 22 East 40th Street, New York 16, New York.)
Circle 9275 inside back cover.

Single seat pressure reducing valves

Valves which act as pressure reducers, relief valves, pump governors with steam, oil, water, gas or air are described in two-color bulletin.

Single-seat, tight-closure valves are available as direct or reverse acting in either bronze or steel. They can be used for initial working pressures to 600 psi up to 750°F and reduced pressures in ranges from 3—150 psi.

(Bulletin on single seat pressure reducing valves, Section 1, is issued by Atlas Valve Company, Dept. P&PSE, 280 South Street, Newark 5, N. J.)
Circle 9276 inside back cover.

Tube forming brochure

Tight bend tubes formed through a cold process method to extremely short radius bends of 1:1 ratio, or less are described in bulletin. Wall thicknesses are controlled resulting in absolute minimum wall thin-out at the outside radius.

Fabricated from aluminum, steel, stainless steel and other alloys, the bends range in sizes from ½" to 3" tube OD.

(Bulletin AEB-25 is available from Aeroquip Corp., Dept. P&PSE, Jackson, Michigan.)
Circle 9277 inside back cover.

Water tube boilers for any firing

Two types of 2-drum water tube factory assembled boilers are featured in 20-page catalog.

Known as VL and VLP, the VL for any firing method is a standardized water tube steam generator that can be shipped built up or knocked down for field erection in large capacities.

VLP designates a packaged type VL with pressure tight casing for oil and/or gas firing. The VLP may be converted to stoker firing at any later time.

Both types feature integral water cooled furnaces and are fully described with section views, dimensions and drawings and mechanical data.

(Catalog SB-57R is issued by Erie City Iron Works, Dept. P&PSE, Erie, Pa.)
Circle 9278 inside back cover.

Packaged demineralizer unit described

Packaged demineralizer can be erected on-site by setting the unit in place and connecting to air and raw water supply, treated water outlet, and open drain.

The units are available in capacities from 2100 to 13,200 gph using raw water with 10 grains per gallon total exchangeable anions.

Operating valves and piping are corrosion-proof PVC and exchange tanks are lined with the same material. Auxiliary polyethylene regenerant tanks are provided for acid and alkali.

(Packaged Demineralizer brochure is available from Cochrane Corp., Dept. P&PSE, 17th Street Below Allegheny Avenue, Philadelphia 32, Pa.)
Circle 9279 inside back cover.

Gearbelt drives catalog

Gearbelt drives with the flexibility of belt drives and the advantages of chain and gear drives are featured in 58-page catalog. Power is transmitted by positive engagement of belt teeth with pulley grooves as in chain drives rather than by friction as in belt drives.

Catalog contains design and installation suggestions, engineering data, and examples, along with tables of hundreds of practical stock drive combinations.

(Bulletin GB-201-A is available from Browning Mfg. Co., Dept. P&PSE, Maysville, Ky.)
Circle 9280 inside back cover.

Flexible shaft assemblies

Standard flexible shaft assemblies catalog features over 180 variations.

Standards are assembled from stock components. They reduce costly and time-consuming engineering consultation, and reduce the time required for delivery.

These assemblies do not take the place of flexible shafts designed for special use but are particularly helpful for those needing a standard assembly in a hurry.

(Flexible Shaft Assemblies Bulletin is available from F. W. Stewart Co., Dept. P&PSE, 4311-13 Ravenswood Avenue, Chicago 13, Illinois.)
Circle 9281 inside back cover.

Pump-tank combination for chemical feeding

Low-cost pump-tank combinations for the accurate and efficient feeding of chemical solutions, and for economical boiler water treatment is subject of bulletin.

Combination is offered in a complete package, including tank, cover, stand, choice of two styles of proportioning pumps, suction shut-off valve, strainer, tubing, etc. Unit is designed to use a minimum of floor space. Features include a 55-gallon molded polyethylene tank with protective steel drum, corrosion-resistance, low initial cost, low maintenance, and extreme flexibility.

Bulletin contains photographs and descriptive information pertaining to two pump-tank combinations. Model for high pressure lines has capacities up to 8.9 into discharge pressures up to 1100 psi. Model for low pressure applications has capacities up to 2 gph against 200 psi, or 1.4 gph against 300 psi.

(Bulletin 1800.20-1 is available from B-I-F Industries, Inc., Dept. P&PSE, 345 Harris Avenue, Providence 1, Rhode Island.)
Circle 9282 inside back cover.

Power circuit breakers for low voltages

Low voltage stored-energy power circuit breakers bulletin includes photographs, diagrams, graphs and charts showing specifications, operating features, dimensions, and ratings for complete line.

Both manual and electrical stored-energy closing mechanisms are described in the complete range of ratings through 600 volts, 4000 amperes.

(Bulletin GEA-5915E is issued by General Electric Company, Dept. P&PSE, Schenectady 5, N.Y.)
Circle 9283 inside back cover.

Pneumatic transmitting rotameters

Pneumatic transmitting rotameters transmit an air signal proportional to fluid rates of flow to remote-located indicators, recorders, controllers, or integrators.

Designed for use with either glass tube or metal-tube rotameters, the devices are mounted directly on, and are magnetically coupled to, the rotameter to sense the rotameter-measured fluid rate of flow.

(Bulletin 18N is issued by Schutte and Koerting Co., Instrument Division, Dept. M-Q, Dept. P&PSE, Cornwells Heights, Bucks County, Pennsylvania.)
Circle 9284 inside back cover.

Controls for drainage and regulators

Steam trap and regulator bulletin gives detailed information in tabbed and indexed form on applications, capacities, sizing and selection, preventive maintenance and trouble shooting.

("Controls for Drainage and Regulation" Catalog is issued by the Clark Mfg. Co., Dept. P&PSE, 1830 East 38th Street, Cleveland 14, Ohio.)
Circle 9285 inside back cover.

Automatic conveyor lubricators

Improvements in two models of automatic conveyor lubricators are described in 8-page catalog. Three fundamental improvements included in the design of one series of models are: individual adjustment of wheel nozzle and a wheel manifold; redesigned trip-mechanism; provision for easy "put-in" and "take-out" of service.

Improvements included in the design of the other series of models are: each unit completely adjustable as to quantity of lubricant discharged into each wheel bearing; air pressure varied in accordance with viscosity of lubricants; elimination of all drippage by the use of a nozzle with automatic shut-off feature.

(Catalog CL659 is issued by J. N. Fauver Co., Inc., Dept. P&PSE, 51 West Hancock Avenue, Detroit 1, Mich.)
Circle 9286 inside back cover.

Full line of variable speed pulleys

Full line of variable speed pulleys — plus related equipment including compound drives, motor bases and frames, wide V-belts and sheaves — is described in 24-page technical catalog. Information includes selection and operating data, horsepower ratings, dimensions and representative applications for the wide variety of sizes and models.

Variable speed pulleys are the cam-operated type which positively maintain desired speed even under overload conditions. They range from fractional to 5 hp with speed ratios from 1.75-1 to 2.6-1. Five wide V-belt pulley models with speed ratios of 3-1 and two high-ratio types providing ratios up to 7.2-1 are also included.

(Pulley catalog is issued by Lovejoy Flexible Coupling Co., Dept. P&PSE, 4949 W. Lake Street, Chicago 44, Ill.)
Circle 9287 inside back cover.

All about toggle switches

Toggle switches and toggle switch assemblies for use in airborne, mobile, marine, electronic, and commercial applications are described in 32-page catalog.

Included also are detailed descriptions, photographs, diagrams, dimensional drawings and specifications tables.

(Catalog MIL-S-3950A is issued by Micro Switch, Division of Minneapolis-Honeywell Regulator Co., Dept. P&PSE, Freeport, Ill.)
Circle 9288 inside back cover.

Multi-shielded drip-proof motors

Five outstanding design features of multi-shielded drip-proof motors are pointed out in 4-page bulletin.

Motors are said to be able to replace totally enclosed motors in many applications where adverse conditions of moisture, humidity, dust, oil and chemicals prevail.

(Bulletin No. 196 is issued by Sterling Electric Motors, Inc., Dept. P&PSE, 5401 Telegraph Road, Los Angeles 22, California.)
Circle 9289 inside back cover.

Technical data aids in choosing chargers

Technical data sheet aids in selecting various models of constant-voltage, silicon-rectifier chargers for stationary-type batteries.

Including curves and statistics on charger performance at various electrical loads, the data sheets also contain diagrams and instructions for installing associated alarms and ground detection systems.

(Technical data on chargers is available from Exide Industrial Division, The Electric Storage Battery Co., Dept. P&PSE, Rising Sun and Adams Avenue, Philadelphia 20, Pennsylvania.)
Circle 9290 inside back cover.

Gives data on flexible hose for diesels

Data on ways to overcome the flexation and vibration problems of diesel pipeline connections are contained in metal hose data sheet.

Charts and diagrams give clear, easy-to-read recommendations for engine exhaust, air intake and oil lines that require flexible, leakproof connections to compensate for vibration, expansion, offset, misalignment and other problems. Many typical installations are diagrammed. Some of these are 90° permanent bends (all hose or with elbows), lateral and vertical offset, expansion and contraction.

Convenient check list will enable users to call upon expert engineering staff for specifications and suggestions on both standard and specialized installations.

(Data Sheet 10-x-552 is issued by Allied Metal Hose Co., Dept. P&PSE, 3746 Ninth Street, Long Island City 1, New York.)
Circle 9291 inside back cover.

Transmits signals for reading, alarm

Four-page brochure describes electric transmission systems for remote pressure reading and maximum or minimum signals at one or more locations.

The illustrated brochure tells how the transmitter comes in standard or explosion-proof cases to be used with two types of receivers — an indicator or a maximum or minimum alarm signal relay.

Concise specifications include dimensions, potentiometer resistance rating, wattage, voltage and amperage for both transmitters and receivers.

("Acragage" bulletin is available from Instrument Division, International Register Company, Dept. P&PSE, 2620 W. Washington Blvd., Chicago 12, Ill.)
Circle 9292 inside back cover.

Describes equipment for services

Equipment for the process industries is described in comprehensive 12-page, two-color bulletin.

Applications and performance characteristics are discussed for pumps, pneumatic conveyors, fluidizing conveyors, rotary compressors and vacuum pumps, horizontal-grate coolers, suspension-type preheaters, positive pressure blowers and gas pumps, and induced draft fans. Operating principles are explained, and photographs show typical installations.

(Bulletin G-3C is issued by the Fuller Company, Dept. P&PSE, Catasauqua, Pa.)
Circle 9293 inside back cover.

Fire extinguishing equipment

Twenty-page catalog lists complete line of fire equipment including hand portable extinguishers, stationary fire equipment, piped systems and large capacity mobile equipment such as fire jeeps and trucks.

(Fire Extinguishing Equipment Catalog is available from Catalog Department, Ansul Chemical Company, Dept. P&PSE, Marinette, Wisconsin.)
Circle 9294 inside back cover.

Safety cleaning solvents

Safety cleaning solvents allow users to select a formulation meeting their specific cleaning requirements.

Series of eleven standard formulations range from low-cost 'wash-up' solvents to high safety factor blends for hazardous locations. Literature lists applications, safety factors, flash points, relative drying time and, price schedule.

(Technical Cleaning Solvents Bulletin is issued by Harco Chemical Co., Dept. P&PSE, Cranford, N.J.)
Circle 9295 inside back cover.

Labyrinth seal bulletin

Floating mechanical labyrinth seal for gas turbines and compressors functions at temperatures as high as 1400°F and shaft speeds up to 150,000 rpm.

(Floating Seal Bulletin is issued by Cartriseal Corporation, Dept. P&PSE, 3515 Touhy Avenue, Lincolnwood, Illinois.)
Circle 9296 inside back cover.

Coal dust, fly-ash control system

New low-cost coal dust and fly-ash control system — from the point of unloading until it reaches the bunkers, by "wetting" and agglomerating the dust before it becomes airborne — is described in 4-page brochure.

The system consists of a wet water mixer, some valves, spray nozzles, one-inch piping and a supply of "wet water" cartridges. No pumps, motors or storage tanks are required. The wet water mixer, which operates on the plant water system, replaces all of these and gives effective dust control at less than 1c of ton of coal handled.

Added moisture is less than ¾ of 1 percent. Dust is controlled at unloading point and at each dust producing point in the handling system.

(Data No. 66B is available from Deynor Corp., Dept. P&PSE, 1 Depot Plaza, Mamaroneck, N.Y.)
Circle 9297 inside back cover.

Graphic rotameter selector aid

Graphic rotameter selector aid bulletin states basic advantages of variable area flow meters and displays the various types of meters in their specific areas of application.

(Bulletin No. 110 is issued by Brooks Rotameter Co., Dept. P&PSE, PO Box 432, Lansdale, Pa.)
Circle 9298 inside back cover.

For measuring torque

Torquometers and indicators in standard ranges from in. oz. full scale through 30,000 in. lb. full scale and high speed capability to 50,000 rpm are illustrated and described in two bulletins.

(Bulletin TM 400C 10-59 "Torque Shaft Assembly" is issued by B & F Instruments, Inc., Dept. P&PSE, 3644 N. Lawrence St., Philadelphia 40, Pennsylvania.)

(Bulletin TM 10-59 "Torquometers" is issued by B & F Instruments, Inc., Dept. P&PSE, 3644 N. Lawrence St., Philadelphia 40, Pa.)
Circle 9299 inside back cover.

Flexible coupling bulletin

Flexible coupling bulletin includes photographs of couplings and installations, diagrams and tables for each type of coupling.

Included also are facts about dynamic balancing, bore specifications and keyway standards.

(Catalog No. 60 is issued by The Thomas Flexible Coupling Co., Dept. P&PSE, Warren, Pa.)
Circle 9300 inside back cover.

Catalogs industrial hose and fittings

Designed to help users of hydraulic, air and fluid systems find the item in shortest length of time, 128-page catalog contains easy-to-find specifications, technical data, sizes, descriptions, applications and installation instructions on hose and hose assemblies, brass and steel tube fittings, hose and tube working tools, hose racks and other specialty products.

(Catalog C-300 is available from The Weatherhead Company, Dept. P&PSE, 128 W. Washington Blvd., Fort Wayne, Indiana.)
Circle 9301 inside back cover.

Cooling water systems corrosion control

Dianodic method of corrosion control and how it has changed the treatment of open recirculating cooling systems is subject of data sheet.

This method is said to produce effective control over pitting and tuberculation even with the relatively low treatment levels of 40-60 ppm.

("A Modern Approach to Cooling Water Treatment" is available from Betz Laboratories, Inc., Dept. P&PSE, Gillingham and Worth Streets, Philadelphia 24, Pa.)
Circle 9302 inside back cover.

Lists mercury switch controls and relays

Mercury switch equipped controls for single stage pressure, two-stage pressure, differential pressure, single-stage temperature, two-stage temperature, liquid level and mechanical movement are listed in 56-page catalog. Also illustrated are transformer-relays and a complete line of hermetically sealed mercury switches.

Each control with accompanying description, specifications and engineering data, can be easily located by a dual index in the catalog.

(Catalog No. 860 is issued by The Mercoid Corp., Dept. P&PSE, 4201 Belmont Avenue, Chicago 41, Ill.)
Circle 9303 inside back cover.

Power convection bulletin

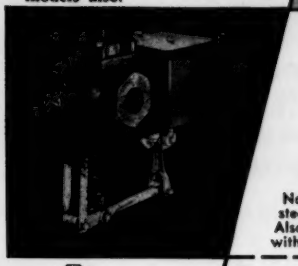
Applications of power convection systems of heat treating furnaces are shown photographically in 8-page bulletin. Schematic flow diagrams of typical power convection systems are reproduced.

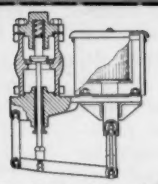
(Bulletin SC-182 is available from Surface Combustion Division, Dept. P&PSE, 2375 Dorr Street, Toledo 1, Ohio.)
Circle 9304 inside back cover.

BIG LINE-UP
BIG PERFORMANCE

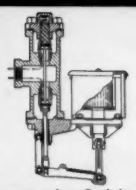
Johnson Solenoid Valves are built for heavy duty service . . . handling, air, water, steam, heavy viscous liquids. No pilots or pistons; powerful leverage design opens smaller valves against 250 lbs. Because of the remoteness of the solenoid, temperatures up to 400° F. are easily handled without adverse effect on the solenoid coil. Bodies are bolted together. Explosion-proof models also.

JOHNSON
Direct Operated
SOLENOID VALVES

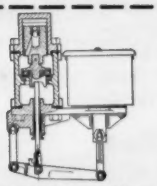




Normally closed service, stainless steel valve and seat. Sizes ⅜"-3". Also for normally open service, and with Jenkins Disc.



3-way valve. Stainless steel valves and seats. Sizes ½"-1½".



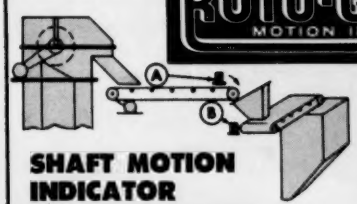
Dashpot construction, cushions closing to avoid water hammer. Jenkins Disc. Sizes ¾"-2".

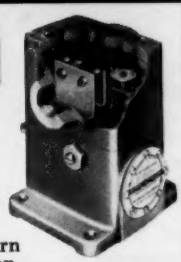
Write for Bulletin "V"

THE JOHNSON CORPORATION
807 Wood St., Three Rivers, Mich.

Circle 9305 inside back cover.

ROTO-GUARD
MOTION INDICATOR





SHAFT MOTION INDICATOR
PROTECTS MACHINERY BY INDICATING STOPPAGE DUE TO OVERLOADING OR MALFUNCTION

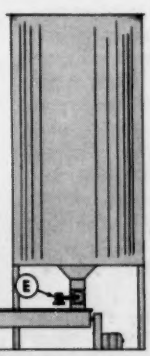
A and B: On end return idlers, warn if conveyor should break, slow or stop.

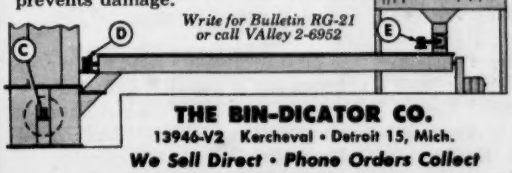
C: On boot pulley, signals slowdown, stoppage, slippage due to overload, boot pulley out of adjustment. Helps prevent fires.

D: On screw conveyor, warns of slowdown due to overloading. Prevents damage.

E: On rotary feeder, warns of slowdown; prevents plugging damage.

Roto-Guards can be wired into interlock system; stoppage of one component automatically stops others; prevents damage.





Write for Bulletin RG-21 or call VAlley 2-6952

THE BIN-DICATOR CO.
13946-V2 Kercheval • Detroit 15, Mich.
We Sell Direct • Phone Orders Collect

Circle 9306 inside back cover.

CUT HERE AND FILE

Plant-Power Services Engineer

nomograph 47a

Determining Prandtl's Number

E. R. ARCHAMBEAU
The Stearns-Roger Mfg. Co.
Denver, Colorado

Prandtl's number is a basic heat transfer relationship which is required for every heat transfer calculation involving a fluid inside a tube. Most empirical equations in common usage for determination of film coefficients use Prandtl's number raised to 0.30, 0.33 and 0.40 power. This factor is multiplied by conductivity. Most conservative equations settle upon 0.33 for the most practical value.

Composite result of research on film coefficients of liquids inside of tubes shows that the coefficient is defined by Nusselt's equation[1] which is:

$$\frac{hD}{K} = a\left[\frac{DG}{Z}\right]^{0.8}\left[\frac{CpZ}{K}\right]^{\frac{1}{3}}$$

This equation resolves itself into the following expression:

$$h = \frac{a}{D}\left[\frac{DG}{Z}\right]^{0.8} \times K\left[\frac{CpZ}{K}\right]^{\frac{1}{3}}$$

where

h = film coefficient
a = an experimentally determined constant
D = diameter of flowing stream
(DG/Z) = Reynolds number
$K\left[\frac{CpZ}{K}\right]^{\frac{1}{3}}$ = Prandtl number raised to the 1/3 power and multiplied by K

The purpose of this nomograph is to solve for this last expression easily and quickly. This expression incorporates all of the physical properties of the tube fluid which will be constant for a given fluid in any one problem. This incorporation will simplify calculations in which many variable factors must be used to seek a final answer. In this expression:

K = Thermal conductivity of fluid, Btu/hr ft² °F/ft
C_p = Specific heat, Btu/lb °F
Z = Viscosity, centipoises

The ranges chosen for the three properties will cover any fluid — liquid or gas — except extremely viscous oils at low temperatures. The viscosity scale was cut off at 4.0 to preserve a reasonable accuracy.

This nomograph has been in constant use in designing heat exchangers since its construction in July, 1959, and a fluid has not been found which did not fall within the limits of the nomograph.

Typical Example

Find the Prandtl group for a fluid inside a heat exchanger tube which has a thermal conductivity (K) of 0.04 Btu/hr ft² °F/ft, a specific heat (C_p) of 0.30 Btu/lb °F, and a viscosity (Z) of 0.03 centipoises.

Connect 0.04 on K scale with 0.03 on C_p scale. Connect the intersection of this line (1) on A with 0.03 on Z scale. Intersection of this line (2) on Prandtl number scale gives a value of 0.025.

LITERATURE CITED

1) McAdams, W.H., "Heat Transmission" Chap 7, 2nd Ed, McGraw-Hill, New York, 1942

nomograph on page 39

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Electric motor operator data sheet

Data Sheet describes two new electric motor operators designed for use with all the company's double-seal ball valves in the ¼" through 4" sizes.

(Data Sheet No. 6 is issued by Jamesbury Corp., Dept. P&PSE, Worcester, Mass.)
Circle 9307 inside back cover.

Low cost rotameter

Low cost means of flow rate indication and alarm signaling is subject of specification sheet. Device is designed for non-corrosive applications where the metering accuracy requirements are not severe.

Device is ideal for purge type service, seal oil systems, bearing lubrication, and cooling water indication.

(Specification Sheet No. DS-130-1 is issued by Brooks Rotameter Co., Dept. P&PSE, P.O. Box 432, Lansdale, Pa.)
Circle 9308 inside back cover.

Dual fuel system

Dual fuel engine which is essentially a diesel engine with a simplified gas-fuel system and special controls for regulating the quantity of gas admitted is capable of burning gaseous fuels, including natural gas and sewage gas, as well as diesel oil.

Safety controls are built-in to provide positive automatic shut-off in case of excessive jacket water temperature, low lube oil pressure or overspeed of the engine. In shutting down, the gas is cut off before the pilot fuel. This safety procedure eliminates the possibility of an explosion due to an accumulation of gas in the exhaust system.

(Bulletin No. EG-B46 is issued by Enterprise Engine & Machinery Co., Dept. P&PSE, 18th and Florida Streets, San Francisco, Calif.)
Circle 9309 inside back cover.

Thermocouple terminal boxes

Weatherproof multi-junction thermocouple terminal boxes have neoprene gasketed covers. The boxes provide protection for the termination of thermocouple extension cable against the effects of oil, dust, dirt, humidity, or any other contaminating environment.

Bulletin describes cast iron and sheet steel boxes and lists their dimensions and capacities which range from 6 to 100 thermocouple circuits.

(Bulletin No. 28 is issued by Thermo Electric Co., Inc., Dept. P&PSE, Saddle Brook, New Jersey.)
Circle 9310 inside back cover.

Gives proper grouting practices

Explaining how to avoid shrinkage through the use of properly applied non-shrink grout is the subject of 16-page publication.

Describing successful grouting techniques with non-shrink grout, the bulletin outlines and illustrates common methods of grouting different types of equipment, the mixing and placing of grout, and cold and hot weather grouting.

Information on recommended mixes and estimating tables, plus actual installations are also included.

(Bulletin E-1d is issued by The Master Builders Company, Dept. P&PSE, Cleveland 3, Ohio.)
Circle 9311 inside back cover.

Vertical, single-stage compressor

Vertical, single-stage compressor has piston displacements from 633 to 1630 cfm with pressures to 125 psi and horsepower ratings to 150.

(Bulletin GG-5H is issued by Joy Mfg. Co., Dept. P&PSE, Oliver Bldg., Pittsburgh 22, Pa.)
Circle 9312 inside back cover.

Adjustable speed drives

Extensive information on line of eddy current coupling adjustable speed drives for 5 to 100 horsepower is contained in a 12-page bulletin.

Publication contains information on the eddy current coupling operating principle, as well as data on torque capabilities, regulation and operation of the entire packaged drive which includes the main drive unit, control enclosure and the operator's control.

Cross-sections and artist's drawings outline construction feature which permit drives to operate over long periods of time with little or no maintenance.

Charts indicate drive unit dimensions, ratings and data, as well as dimensions of the control enclosure and operator's control.

(Bulletin GEA-6885 is issued by General Electric Co., Dept. P&PSE, Schenectady 5, N.Y.)
Circle 9313 inside back cover.

Building trade pumps

Split case building trade pumps are available in both packed and sealed types, in sizes from 1½" through 4" discharge, and packed type is available also through 8" discharge.

Capacity and head ranges of the packed type pumps are up to 2,600 gpm and 280 feet respectively, and capacity and head ranges of the sealed type are up to 750 gpm (3500 rpm) and 950 gpm (1750 rpm) and up to 350 feet (3500 rpm) and 170 feet (1750 rpm), respectively. Temperature limit for liquids handled by the sealed type pumps is 180°F; for the packed type 250°F. Motor sizes range from 1 to 75 hp.

(Building Trade Pumps Catalog is issued by Peerless Pump Division, Food Machinery and Chemical Corp., Dept. P&PSE, 301 W. Avenue 26, Los Angeles 31, Calif.)
Circle 9314 inside back cover.

Bulletin issued on control valve

Single control valve for zeolite softeners, ion exchange units, and filters, features no leakage, low pressure loss and simple operation with integral hydraulic pilot.

(Bulletin WC-122 is issued by Graver Water Conditioning Co., Dept. P&PSE, 216 West 14th Street, New York 11, New York.)
Circle 9315 inside back cover.

Lists 35 models of package boilers

Tabulated data on 35 models of an automatic package boiler ranging from 15 through 600 hp are contained in four-page bulletin.

Illustrated design specifications of the unit and the integral burner system for oil, gas or combination fuels are presented. Fireside and waterside circulation patterns are diagrammed.

A special section deals with hot water applications for high temperature as well as normal hot water system service.

(Bulletin BE-400 is issued by Boiler Engineering & Supply Co., Inc., Dept. P&PSE, Phoenixville, Pa.)
Circle 9316 inside back cover.

Hydrocarbon detector

Bulletin describes portable hydrocarbon detector based upon the flame ionization detector recently developed for gas chromatography. It accurately detects and measures fractions of parts per million of such organic carbon compounds as hydrocarbons, aldehydes, ketones, alcohols, amines with a sensitivity range adjustable from as low as 0-1 ppm full scale to 10% full scale.

(Hydrocarbon Detector brochure is issued by Instrument Division, Perkin-Elmer Corporation, Dept. P&PSE, Norwalk, Conn.)
Circle 9317 inside back cover.

COMPRESSED AIR
SEPARATOR · FILTER · TRAP
MURPHY
TRIUMPH AA

Installed near point of use, it separates and ejects moisture automatically, then filters out all scale, rust or other impurities and delivers air clean and dry; **of instrument quality.**

Write now for **FREE** Data Sheet No. 2567.

JAMCO

JAS. A. MURPHY & CO., INC.
1419 EAST HIGH STREET, HAMILTON, OHIO

Circle 9318 inside back cover.

THERMOCOUPLES
THAT WILL WITHSTAND
3000°F AND
UP TO 50,000 PSI

LONG LIFE
Sheath Diameters, .04 to .032
Thermocouple Lengths to 50 feet

Complete Thermocouples made to every requirement.

NEW, SIMPLE CONSTRUCTION

A metallic sheath compressed over ceramic insulated wire. Sheath can be bent and weldments can be performed without loss of insulation.

Write for new Bulletins ▶ 3.8A for complete thermocouples. 4 for AEROPAK Ceramic insulated wire.

Aero Research
INSTRUMENT COMPANY, INC.

DEPT. PSE, 315 NORTH ABERDEEN • CHICAGO 7, ILL.
Sales Representatives throughout the United States and Canada

Circle 9319 inside back cover.

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Determining Prandtl's Number

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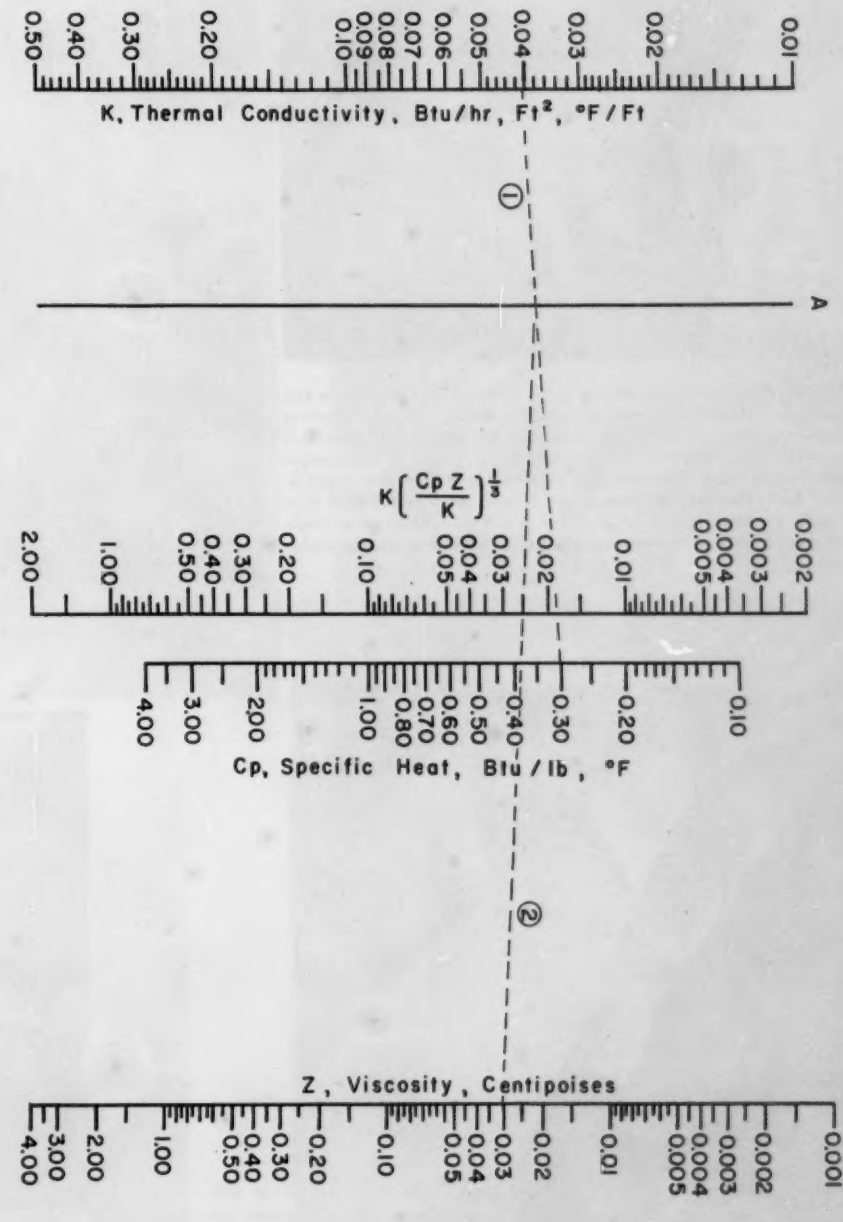

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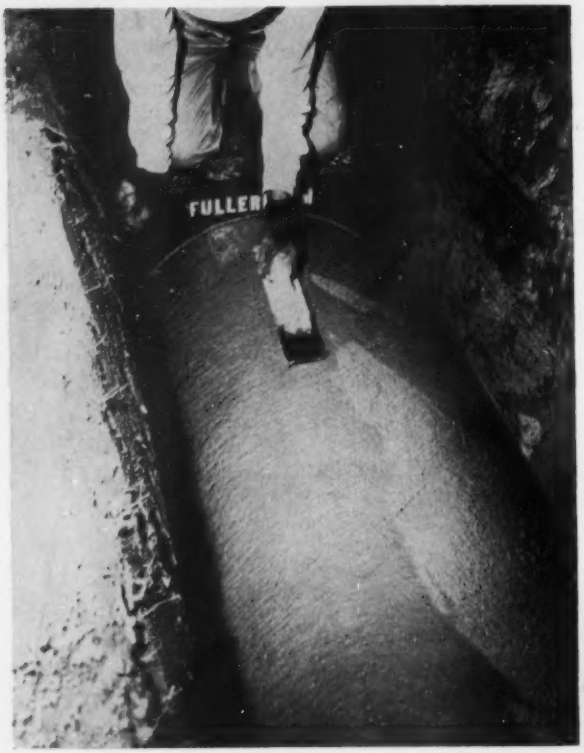
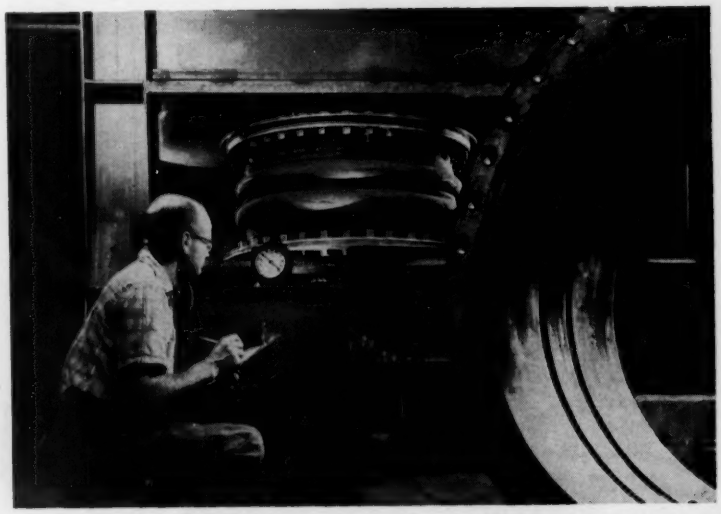
March, 1960

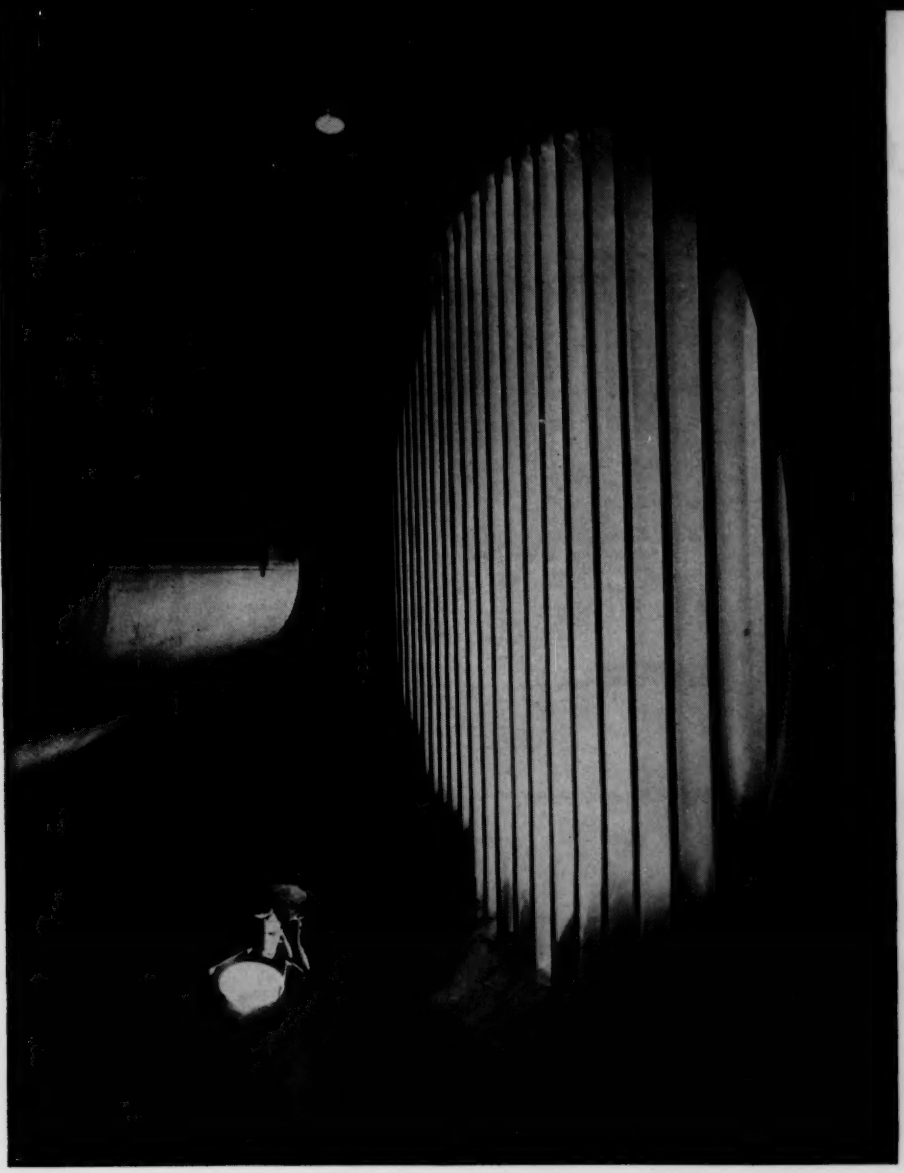
PHOTO NEWS



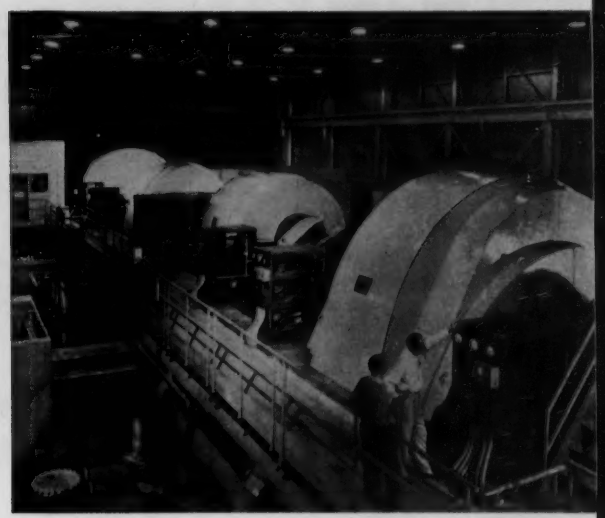
POURED PIPE — This concrete pipe (top) has been poured by a new continuous process in a freshly cut ditch. Developed by Fullerform Continuous Pipe Corp., Phoenix, Ariz., with the assistance of Goodyear Aircraft Corp. engineers, the equipment is being used to build irrigation pipe. Using a Goodyear-built inflatable inner form and a mobile outer form, (bottom) the process can form as much as 600 ft of pipe at a time with rates at 8 to 12 ft per min. Ready-mix concrete trucks are used (right) in a continuous stream to service the pouring equipment.

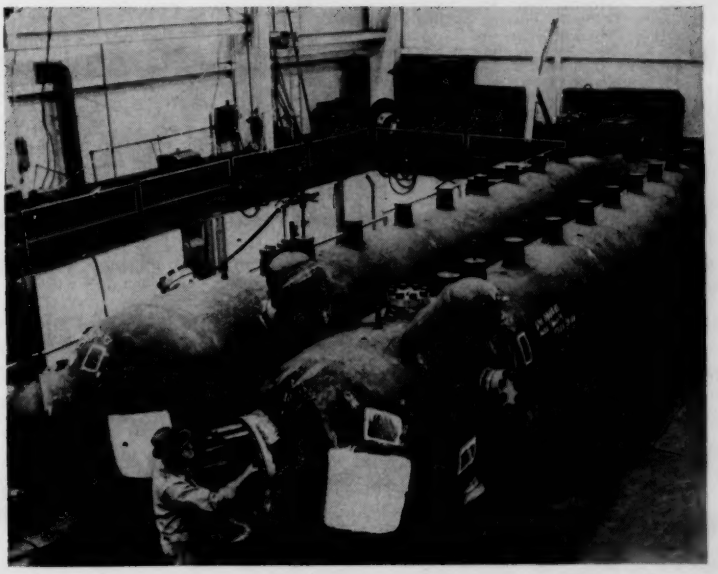


UNDER PRESSURE — One of a series of Viton-lined neoprene expansion joints is hydrostatically tested at The Garlock Packing Company, Palmyra, N.Y. First of its kind ever manufactured, the double-arch joints are located in exhaust lines carrying turbine steam to condensers in nuclear submarines. The carcass of the joints are asbestos reinforced with internal steel body rings.



A LOT OF WIND — This huge supersonic wind tunnel at Arnold Engineering Development Center will produce speeds of approximately 3000 mph. Secret is four-motor drive system (bottom) built by Westinghouse to develop 216,000 hp. Two of the motors, rated at 83,000 hp each, are the largest synchronous motors ever built. They stand 21½ ft high and weigh 225. The 122-ton rotors spin at a rate of 600 rpm.





TEN MILES OF ONE-INCH STAINLESS TUBING are contained in this 60-ton heat exchanger destined for Con Ed's nuclear station at Indian Point, N.Y. The unit is shown undergoing inspection in The Babcock & Wilcox Company's Barberton, Ohio, boiler works. B&W is designer and builder of the new station's nuclear system.

NEW LITERATURE

Regulating relief valve

Two-page bulletin describes regulating relief valve for oil, water pressures to 500 psi up to 250°F.

Included also are operation and installation information as well as valve photos, drawings and a chart showing the rate of oil or water flow through the valve.

(Regulating Relief Valve Bulletin is issued by Atlas Valve Co., Dept. P&PSE, 280 South Street, Newark 5, New Jersey.)
Circle 9320 inside back cover.

Explosion-proof housings made of cast-aluminum

Cast-aluminum explosion-proof housing catalog contains detailed drawings, photographs, and dimension charts for the complete line.

Explosion-proof housings and fittings, multiple hub boxes, junction boxes, and vertical sealing fittings are included.

In addition, a two-page section is devoted to explosion-proof and dust-tight housings with glass windows for instruments and meters.

(Bulletin No. 160 is issued by The Adalet Mfg. Co., Dept. P&PSE, 14300 Lorain Avenue, Cleveland 11, Ohio.)
Circle 9321 inside back cover.

Mineral insulated thermocouples

Mineral insulated thermocouples catalog gives simple steps for ordering over 24,000 assembly combinations from factory stock of all components.

The thermocouples are said to be flexible, and have high temperature range, small size probes, fast response and corrosion resistance.

(Catalog No. 300 is issued by Conax Corp., Dept. P&PSE, 2300 Walden Avenue, Buffalo 25, N.Y.)
Circle 9322 inside back cover.

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CLEVELAND 9, OHIO, 5414 Archmere Ave., SHadyside 1-9452

LOS ANGELES 57, CALIFORNIA, Wettstein, Nowell, & Johnson, Inc., Jerry Holtz, 672 S. La Fayette Park Place, DUnkirk 8-2286

NEW YORK 17, NEW YORK, William J. Prohovich, District Manager, 369 Lexington Avenue, MUrray Hill 6-7738

PHILADELPHIA, PENNSYLVANIA, William J. Prohovich, District Manager, 729 School Line Drive, King of Prussia, Pennsylvania, BR 5-2589

PITTSBURGH 22, PENNSYLVANIA, 544 Oliver Bldg., ATlantic 1-2783

PORTLAND 5, OREGON, Wettstein, Nowell & Johnson, Inc., 337 Pittock Block, 921 SW Washington St., CApitol 8-4107

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SOUTHEASTERN STATES, Joe H. Howell, 40 Peachtree Place, N.W. Atlanta 9, Georgia, TRinity 2-2235

THAT'S INTERESTING

Knights in shining armor

Like knights in shining armor, "Armoured Anodes" provide protection for hot water heaters.

The protection for the anode which is manufactured by The Patrol Valve Company of Cleveland, Ohio consists of corrosion-resistant Alcoa aluminum with holes in it at regular intervals.

The holes expose only about 15 percent of the anode's surface to the water, still ample for complete tank protection. As a result, the knight in shining armor has a long period of duty before needing replacement . . . and helps to prevent life-shortening damage to the water tank.

Tiny fire alarm slips over nail

Fire alarm siren designed to go off when room temperature reaches 135 degrees, a level at which fires are normally not out of control, weighs less than 1 lb and is installed merely by slipping over a nail located anywhere near the ceiling. No wiring of any kind is used.

Designed by the Arandell Products Co. of Philadelphia the alarm uses two ordinary flashlight batteries to set off the siren.

'Do-it-yourself' blast

Low-cost solar furnace for high temperature research and testing is available in "do-it-yourself" kit form or completely assembled from Waltham Precision Instrument Co., 221 Crescent Street, Waltham, Mass.

The device enables scientists, metallurgists, environmental test and reliability engineers to further their study of elements and materials.

What good is specialized business publication advertising?

Frank Kistenberger
Metallizing Engineering Co., Inc.

Sells industry

No one is in a better position to give a hard-boiled, practical answer to this question than the men who spend their working lives on the sales front . . . the men the ads are supposed to help . . . the men who sell.

Here is the statement of a salesman who knows what advertising does for him when it appears in the industrial, trade or professional publications that serve the specialized market to which he sells:

Says Mr. Kistenberger:

"I happen to know that better than 50% of my sales to new companies can be traced to leads from our business paper advertising. Another 25% of my sales to new owners I close after following up leads that can't be traced directly to our advertising, but I know darn well that that's where they come from because that's about the only place they could learn about our metallizing systems.

"It's been my experience that our trade advertising is getting to the right people. In many cases this man is an executive who is hard to see on a cold call. But he's a guy that will take the time and trouble to read and he's just the one to drum up interest in metallizing down the line in his company. In other words, you get more action if the suggestion comes down to the production department or the plant engineer from this executive. Of course, I don't mean to say that people will just read about a product like ours and instruct someone to write out an order. It's not that simple. But they do know about metallizing from our advertising and sometimes a surprising amount. That was particularly true of our new ceramic spraying equipment which was introduced last year and which got us into fields we'd never been in before. I think that getting a new product known is usually a pretty tough job but the leads our advertising got us were a big help in reaching the right people."

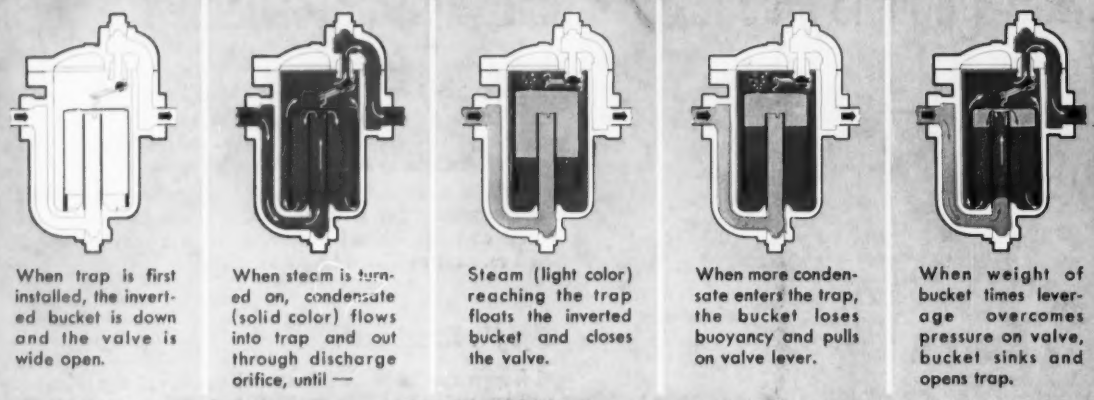
Why not ask your own salesmen what your company's business publication advertising does for them. If their answers are generally favorable you can be sure that your business publication advertising is really helping them sell. If too many answers are negative it could well pay you to review your advertising objectives – and to make sure the publications that carry your advertising are read by the men who must be sold.

PLANT and POWER SERVICES ENGINEER

NBP

One of the 207 members of National Business Publications, Inc. ...each of which serves a specialized market in a specific industry, trade or profession.

This simple trap operating principle provides the efficiency, dependability and freedom from maintenance necessary for the most profitable use of steam



When trap is first installed, the inverted bucket is down and the valve is wide open.

When steam is turned on, condensate (solid color) flows into trap and out through discharge orifice, until —

Steam (light color) reaching the trap floats the inverted bucket and closes the valve.

When more condensate enters the trap, the bucket loses buoyancy and pulls on valve lever.

When weight of bucket times leverage overcomes pressure on valve, bucket sinks and opens trap.

Key: condensate steam steam bubbles air bubbles

ARMSTRONG INVERTED BUCKET STEAM TRAPS

are designed and made to give you these big benefits:

● Amstrong Traps, the first inverted bucket steam traps, now represent the most advanced development of this time-proven principle. They provide all the advantages necessary for efficient, economical condensate drainage from virtually all types of steam using equipment.

1. *No steam loss* – Steam never reaches the orifice even when there is no condensate load.
2. *Automatic air elimination* – Vent in trap bucket passes air and other non-condensibles through to be discharged with condensate.
3. *No cooling leg required* – Condensate is discharged at steam temperature as fast as it reaches the trap because trap operates on difference in density between steam and water not on temperature.
4. *Operates on any back pressure* — Failure of one trap in system will not cause others to open because high back pressure does not affect an Armstrong trap other than to reduce capacity. As long as there is a pressure differential across the orifice the trap will close on steam and open for condensate.
5. *Unaffected by ordinary dirt* — Swirling action of condensate keeps dirt in suspension until discharged with condensate, prevents it from lodging in valve.
6. *Completely dependable* — Proved design plus the use of all stainless steel working parts assure continuity of service and length of service unmatched by any other trap.
7. *Big capacity in a small, economical package* — Armstrong design gives you the highest practical capacity for any given pressure. And remember, Armstrong capacity ratings are based on *hot* condensate at the *working pressure differential* stated, not on theoretical orifice capacities.

Further information on these advantages plus much additional information is given in the 48 page Armstrong Steam Trap Book. Ask your local Armstrong Representative or write direct.

860 Series for low pressure heating service.

800 Series, side inlet, side outlet.

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880 Series, integral strainer.

200 Series, bottom inlet, top outlet.

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The 48 page Armstrong Steam Trap Book tells how to correctly size, install and maintain steam traps for any pressure, any temperature, any load plus full catalog data on Armstrong Steam Traps. Ask for Catalog K.

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